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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 12, NUMBER 21
NOVEMBER 1, 1979

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SELECTED WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Research and Technology, U.S. Department of the Interior

VOLUME 12, NUMBER 21
NOVEMBER 1, 1979

W79-09331 -- W79-09580

The Secretary of the U.S. Department of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus.** Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency. A directory of the Centers appears on the inside back cover.

Supplementary documentation is being secured from established discipline-oriented abstracting and indexing services. Currently an arrangement is in effect whereby the Bio-Science Information Service of Biological Abstracts supplies WRSIC with relevant references from the several subject areas of interest to our users. In addition to Biological Abstracts, references are acquired from Bioresearch Index which are without abstracts and therefore also appear abstractless in SWRA. Similar arrangements with other producers of abstracts are contemplated as planned augmentation of the information base.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center
Office of Water Research and Technology
U.S. Department of the Interior
Washington, DC 20240

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03 WATER SUPPLY AUGMENTATION AND CONSERVATION
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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

SYMPOSIUM ON THE PHYSICS AND CHEMISTRY OF ICE,
For primary bibliographic entry see Field 2C.
W79-09342

THE DISTORTION OF A WATER MOLECULE IN ICE,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
E. Whalley.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 13-31, 1978. 2 fig, 1 tab, 65 ref.

Descriptors: *Water properties, *Ice, *Reviews, *Water structure, Water, Condensation, Freezing, Water vapor, Crystals, Molecular structure, Hydrogen bonding, Electrical properties, Mathematical models, Polarity, Refractivity, Properties, Water molecule, Potential energy.

The experimental evidence for the distortion of a water molecule when it is condensed to form ice was reviewed. The specific distortions considered are the changes in inter-nuclear distances, energy and its derivatives with respect to nuclear motion, and electrical moments and polarizabilities and their response to nuclear motion. Some of the properties of ice can be expanded as Fourier or Taylor series in the ratio r/R of the O-H to the O-O distances, and these expansions were used to relate various properties of the intermolecular potential energy, of the electrical dipole moments, and of the polarizability. For example, the amplitude of the orientation polarization can be related to the infrared intensity of the fundamental and first overtone infrared bands. The principal conclusion from this paper was that many of the molecular properties of ice can be correlated by expanding them in the displacement of the in-phase vibration. (See also W79-09342) (Humphreys-ISWS)
W79-09343

CLATHRATE ICES--RECENT RESULTS,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
For primary bibliographic entry see Field 2C.
W79-09344

X-RAY DETERMINATION OF THE STRUCTURE OF ICE IV,
California Inst. of Tech., Pasadena. Div. of Geological and Planetary Sciences.
For primary bibliographic entry see Field 2C.
W79-09345

ORIGIN OF THE HIGH-FREQUENCY TRANSLATIONAL BANDS OF ICE I,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
For primary bibliographic entry see Field 2C.
W79-09346

THE TRANSLATIONAL LATTICE-VIBRATION RAMAN SPECTRUM OF SINGLE-CRYSTAL ICE IH,
Centre Univ. de Savoie, Chambery (France). Lab. de Spectrometrie Raman-Laser.
For primary bibliographic entry see Field 2C.
W79-09347

CONFIGURATIONAL STATISTICS,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Physics.
For primary bibliographic entry see Field 2C.
W79-09348

VACANCIES IN PURE ICE STUDIED BY POSITRON ANNIHILATION TECHNIQUES,
Risoe National Lab., Roskilde (Denmark). Dept. of Chemistry.
For primary bibliographic entry see Field 2C.
W79-09349

VACANCIES IN HF-DOPED AND IN IRRADIATED ICE BY POSITRON ANNIHILATION TECHNIQUES,
Risoe National Lab., Roskilde (Denmark). Dept. of Chemistry.
For primary bibliographic entry see Field 2C.
W79-09350

INTERACTION OF POINT DEFECTS IN ICE,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festkorperphysik.
For primary bibliographic entry see Field 2C.
W79-09351

THEORETICAL MODELS FOR INTERPRETING THE DIELECTRIC BEHAVIOUR OF HF-DOPED ICE,
Handsworth Grammar School, Birmingham (England).
For primary bibliographic entry see Field 2C.
W79-09352

ELECTRICAL CONDUCTIVITY AND RELAXATION IN ICE CRYSTALS WITH KNOWN IMPURITY CONTENT,
New Mexico Inst. of Mining and Technology, Socorro.
For primary bibliographic entry see Field 2C.
W79-09353

EFFECT OF PRESSURE ON THE DIELECTRIC PROPERTIES OF ICE IH SINGLE CRYSTALS DOPED WITH NH3 AND HF,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festokoerperphysik.
For primary bibliographic entry see Field 2C.
W79-09354

ELECTRICAL BEHAVIOUR OF FINELY DIVIDED ICE,
British Antarctic Survey, Cambridge (England).
For primary bibliographic entry see Field 2C.
W79-09355

THE ELECTRICAL PROPERTIES OF ICE SURFACES,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
For primary bibliographic entry see Field 2C.
W79-09356

DIELECTRIC PROPERTIES OF DISLOCATION-FREE ICE,
Army Terrestrial Sciences Center, Hanover, NH.
For primary bibliographic entry see Field 2C.
W79-09357

MEASUREMENTS OF THE ELECTRICAL PROPERTIES OF ICE IH SINGLE CRYSTALS BY ADMITTANCE AND THERMALLY STIMULATED DEPOLARIZATION TECHNIQUES,
Modena Univ. (Italy).
For primary bibliographic entry see Field 2C.
W79-09358

INELASTIC NEUTRON SCATTERING FROM ICE AND OTHER PROTON-CONTAINING SUBSTANCES,
Institut Max von Laue-Paul Langevin, Grenoble (France). Centre de Tri.
For primary bibliographic entry see Field 2C.
W79-09359

THERMAL CONDUCTIVITY OF ICE IN THE TEMPERATURE RANGE 0.5 TO 5.0 K,
CEA Centre d'Etudes Nucleaires de Grenoble (France). Service des Basses Temperatures.
For primary bibliographic entry see Field 2C.
W79-09360

RADIATION DAMAGE IN ICE AT LOW TEMPERATURES STUDIED BY PROTON CHANNELLING,
Neuchatel Univ. (Switzerland). Inst. de Physique.
For primary bibliographic entry see Field 2C.
W79-09361

THE ORIENTATION POLARIZATION IN HEXAGONAL ICE PARALLEL AND PERPENDICULAR TO THE C-AXIS,
Department of Fisheries and Environment, Ottawa (Ontario). Inland Waters Directorate.
For primary bibliographic entry see Field 2C.
W79-09362

THE INFLUENCE OF THE RATE OF DEFORMATION ON THE ELECTRICAL PROPERTIES OF ICE MONOCRYSTALS,
Stuttgart Univ. (Germany, F.R.). Physikalisches Inst.
For primary bibliographic entry see Field 2C.
W79-09363

CO2 IN NATURAL ICE,
Bern Univ. (Switzerland). Physikalisches Inst.
For primary bibliographic entry see Field 2C.
W79-09364

THE RADIO-FREQUENCY BIREFRINGENCE OF POLAR ICE,
Scott Polar Research Inst., Cambridge (England).
For primary bibliographic entry see Field 2C.
W79-09365

DIELECTRIC PERMITTIVITY OF GLACIER ICE MEASURED IN SITU BY RADAR WIDE-ANGLE REFLECTION,
Wisconsin Univ.-Madison. Geophysical and Polar Research Center.
For primary bibliographic entry see Field 2C.
W79-09366

THE ACTIVATION ENERGIES OF TEMPERATE SNOW SAMPLES,
Saint Andrews Univ. (Scotland). School of Physical Sciences.
For primary bibliographic entry see Field 2C.
W79-09367

THE CORE STRUCTURE AND THE MOBILITY OF DISLOCATIONS IN ICE,
Birmingham Univ. (England). Dept. of Physics.
For primary bibliographic entry see Field 2C.
W79-09368

COOPERATIVE MOVEMENT OF H2O MOLECULES AND DYNAMIC BEHAVIOUR OF DISLOCATIONS IN ICE IH,
Institut National des Sciences Appliquees, Lyon (France). Groupe d'Etudes de Metallurgie Physique et de Physique des Materiaux.
For primary bibliographic entry see Field 2C.
W79-09369

INELASTIC BEHAVIOUR OF ICE IH SINGLE CRYSTALS IN THE LOW-FREQUENCY RANGE DUE TO DISLOCATIONS,
Institut National des Sciences Appliques, Lyon (France). Groupe d'Etudes de Metallurgie Physique et de Physique des Materiaux.
For primary bibliographic entry see Field 2C.
W79-09370

OBSERVATION OF BASAL DISLOCATIONS IN ICE BY ETCHING AND REPLICATING,
National Research Council of Canada, Ottawa (Ontario). Div. of Building Research.
For primary bibliographic entry see Field 2C.
W79-09371

Field 1—NATURE OF WATER

Group 1A—Properties

X-RAY TOPOGRAPHIC STUDIES OF DISLOCATIONS IN VAPOR-GROWN ICE CRYSTALS,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 2C.
W79-09372

STUDIES OF CRYSTAL IMPERFECTIONS IN ICE WITH REFERENCE TO THE GROWTH PROCESS BY THE USE OF X-RAY DIFFRACTION TOPOGRAPHY AND DIVERGENT LAUE METHOD,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
For primary bibliographic entry see Field 2C.
W79-09373

A DEFORMATION MECHANISM MAP OF ICE,
Hokkaido Univ., Sapporo (Japan). Dept. of Applied Physics.
For primary bibliographic entry see Field 2C.
W79-09374

THE CREEP ACTIVATION ENERGIES OF ICE,
Birmingham (England). Dept. of Physics.
For primary bibliographic entry see Field 2C.
W79-09375

DEFORMATION OF ICE SINGLE CRYSTALS CLOSE TO THE MELTING POINT,
Department of Fisheries and Environment, Ottawa (Ontario). Inland Waters Directorate.
For primary bibliographic entry see Field 2C.
W79-09376

SHORT-TERM RHEOLOGY OF POLYCRYSTALLINE ICE,
National Research Council of Canada, Ottawa (Ontario). Div. of Building Research.
For primary bibliographic entry see Field 2C.
W79-09377

THE EFFECT OF ANISOTROPY ON THE CREEP OF POLYCRYSTALLINE ICE,
Melbourne Univ., Parkville (Australia). Dept. of Meteorology.
For primary bibliographic entry see Field 2C.
W79-09378

THE INFLUENCE OF ICE-CRYSTAL SIZE ON CREEP,
Wisconsin Univ.-River Falls. Dept. of Plant and Earth Sciences.
For primary bibliographic entry see Field 2C.
W79-09379

THE CREEP OF NACL-DOPED ICE MONOCRYSTALS,
Birmingham Univ. (England). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 2C.
W79-09380

ON THE RELATIONSHIPS BETWEEN LOW-DENSITY AMORPHOUS SOLID WATER AND ICE IH,
Chicago Univ., IL. Dept. of Chemistry; and Chicago Univ., IL. James Frank Inst.
For primary bibliographic entry see Field 2C.
W79-09381

DYNAMICAL PROCESSES AT THE ICE-WATER INTERFACE DURING SOLIDIFICATION,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festokoerperphysik.
For primary bibliographic entry see Field 2C.
W79-09382

CHARGE SEPARATION BY COLLISION OF ICE PARTICLES ON METALS: ELECTRONIC SURFACE STATES,
Eidgenoessische Inst. fuer Schneeund Lawinenforschung, Davos (Switzerland).
For primary bibliographic entry see Field 2C.
W79-09383

OPTICAL ABSORPTION SPECTRA OF H2O ICE DOPED WITH YTTERBIUM CHLORIDE YBCL3,
Centre National de la Recherche Scientifique, Orsay (France). Lab. Aime Cotton.
For primary bibliographic entry see Field 2C.
W79-09384

MOLECULAR ORBITAL CALCULATIONS OF WATER-ICE SURFACE INTERACTIONS,
Missouri Univ.-Rolla. Dept. of Physics.
For primary bibliographic entry see Field 2C.
W79-09385

FRAZIL NUCLEATION MECHANISMS,
Wheeling Coll., WV. Dept. of Physics.
For primary bibliographic entry see Field 2C.
W79-09386

STRUCTURE AND BEHAVIOUR OF GRAIN BOUNDARIES IN POLYCRYSTALLINE ICE,
Hokkaido Univ., Sapporo (Japan). Dept. of Applied Physics.
For primary bibliographic entry see Field 2C.
W79-09387

CRYSTALLOGRAPHIC STRUCTURE OF POLYCRYSTALLINE ICE,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
For primary bibliographic entry see Field 2C.
W79-09388

REGELATION AND THE DEFORMATION OF WET SNOW,
Army Terrestrial Sciences Center, Hanover, NH.
For primary bibliographic entry see Field 2C.
W79-09391

THERMAL GROUND-WATER DISCHARGE AND ASSOCIATED CONVECTIVE HEAT FLUX, BRUNEAU-GRAND VIEW AREA, SOUTHWEST IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
H. W. Young, R. E. Lewis, and R. L. Backsen.
Geological Survey Water-Resources Investigations 79-62 (open-file report), May 1979. 17 p, 1 fig, 1 plate, 2 tab, 9 ref.

Descriptors: *Geothermal studies, *Thermal springs, *Withdrawal, *Irrigation wells, *Well data, Water temperature, Water yield, Water levels, Heat transfer, Convection, *Southwest Idaho.

The Bruneau-Grand View area occupies about 1,100 square miles in southwest Idaho. The area has a rural population dependent on ground-water irrigation. Temperature of the ground water ranges from 15 C to more than 80 C. Ground water for irrigation is obtained from flowing and pumped wells. Discharge of thermal ground water from 104 irrigation wells and from 5 hot springs in 1978 was about 50,500 acre-feet. Convective heat flux from the geothermal system associated with this discharge was 4.97 x 10 to the 7th power calories per second. (Woodard-USGS)
W79-09403

GEOPRESSURE IN THE CARRIZO-WILCOX AQUIFER SYSTEM OF TEXAS,
Geological Survey, NSTL Station, MS. Water Resources Div.
J. B. Wesselman.
In: Proceedings of the Third Geopressured-Geothermal Energy Conference, Vol. 1, University of Southwestern Louisiana, Lafayette, Louisiana, p GI-425 - GI-438, November 16-18, 1977. 2 fig, 8 tab. Published by University of Southwestern Louisiana, Lafayette, Louisiana.

Descriptors: Hydrogeology, *Tertiary period, *Gulf Coastal Plain, *Texas, *Groundwater barriers, *Geochemistry, Cenozoic Era, Structural geology, Depth, Water pressure, Earth pressure, Aquifers, Confined water, Maps, *Geopressure, *Carrizo-Wilcox aquifer system.

The normally pressured Carrizo-Wilcox aquifer system in Texas terminates downdip in a major growth-fault system. The faults are rooted in geopressured sediments of Cretaceous and Tertiary age and trend subparallel to the Texas coast. The fault system continues into Mexico and Louisiana. The top of the geopressured zone occurs in the lowermost sediments of the Carrizo-Wilcox aquifer system at the updip edge of the growth-fault system. All Carrizo-Wilcox sediments are geopressured 6 to 30 miles downdip from this juncture. Ground water moves or has moved from the geopressured sediments through the fault system into the normally pressured aquifers. Zones of relatively fresh, warmer-than-normal water, which originated in the geopressured sediments, are present in normally pressured aquifers more than 10 miles updip from any geopressured Carrizo-Wilcox sediments. The depth to the geopressured zone varies with the gross lithologic character and formation geometry of the sediments. The top of the geopressured zone is downwarped where large sand bodies drain water from the geopressured sediments and upwarped where the sand bodies are absent or discontinuous. (Woodard-USGS)
W79-09409

USE OF HYDROGEOLOGIC MAPPING TECHNIQUES IN IDENTIFYING POTENTIAL GEOPRESSURED-GEOTHERMAL RESERVOIRS IN THE LOWER RIO GRANDE EMBAYMENT, TEXAS,
Geological Survey, NSTL Station, MS. Water Resources Div.
R. H. Wallace, Jr., R. E. Taylor, and J. B. Wesselman.
In: Proceedings of the Third Geopressured-Geothermal Energy Conference, Vol. 1, University of Southwestern Louisiana, Lafayette, Louisiana, GI-1 - GI-88, November 16-18, 1977. 9 fig, 6 tab, 50 ref. Published by University of Southwestern Louisiana, Lafayette, Louisiana.

Descriptors: *Hydrogeology, *Subsurface mapping, *Gulf Coastal Plain, *Texas, *Geothermal studies, Structural geology, Isotherms, Salinity, High pressure, Thermal conductivity, Heat transfer, Confined water, Methane, Natural gas, Oil, Exploration, Geochemistry, Diagenesis, Underground storage, Borehole geophysics, *Geopressured-geothermal energy, *Alternate energy resources, *Rio Grande embayment, Computer techniques.

Hydrogeologic maps presented in this report were prepared to assist those seeking to assess geopressured-geothermal energy resources; to understand origin, migration, and accumulation of hydrocarbons; and to safely manage the underground storage of liquid wastes in the Gulf Coast area. Variations in altitude of fluid-pressure gradient, temperature, and salinity surfaces within the geologic framework are shown by means of depth contours for a part of the lower Rio Grande embayment, Texas. About 1,000 well logs provided the data base for this study. Pressure, temperature, and salinity maps reflect variations in physical and chemical characteristics of subsurface fluids, mainly water, with depth. Interpretations based on this knowledge provide valuable insight into hydrologic, hydrodynamic, and hydrochemical processes occurring within the geologic framework of deep, young, sedimentary basins. The geologic framework, especially formation geometry, determines avenues and rates of fluid movement. Gross lithologic changes appear as broad upwarps or downwarps of the pressure, temperature, and salinity surfaces. Localized highs and lows on these surfaces near fault traces usually represent upward discharge of compaction effluents from greater depths along faults. (Woodard-USGS)
W79-09410

2. WATER CYCLE

2A. General

REMOTE SENSING APPLICATIONS TO HYDROLOGIC MODELING IN THE SOUTHERN SIERRA NEVADA AND PORTIONS OF THE SAN JOAQUIN VALLEY, VOL. I,
California Univ., Santa Barbara. Dept. of Geography.
For primary bibliographic entry see Field 7B.
W79-09422

STUDY OF WATER RESOURCES WITH THE AID OF SPACECRAFT IN THE UNITED STATES,
For primary bibliographic entry see Field 7B.
W79-09501

2B. Precipitation

SCPP FORECASTING SUPPORT, INTERIM PROGRESS REPORT, VOL. II (EXPERIMENTAL DAY SUMMARIES) FOR PERIOD 1 DECEMBER 1978 - 30 JUNE 1979,
Electronic Techniques, Inc., Fort Collins, CO.
J. O. Rhea, and J. L. Le Compte.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-298 498, Price codes: A12 in paper copy, A01 in microfiche. July 1979. Prepared for U.S. Department of Interior, Bureau of Reclamation Office of Atmospheric Resources Management, Denver, CO. 273 p, 218 fig, 3 tab. 9-07-85-V0021.

Descriptors: *Forecasting, *Weather forecasting, *Sierra Cooperative Pilot Project, Rawinsondes, Precipitation(Atmospheric), Meteorology, Data collections, Satellites(Artificial), Aircraft, Condensation, Temperature, Remote sensing, Wind velocity, Weather data, Weather patterns.

A summary of field services performed and analyses completed to date by Electronic Techniques, Inc. (ETI) for the Sierra Cooperative Pilot Project is presented in this two volume work. Volume II is comprised exclusively of a discussion of conditions for each priority I and II experimental day, as well as the heavy precipitation day of January 11, 1979. Information for each day includes a discussion time sections of Sheridan rawinsondes, Blue Canyon hourly precipitation, aircraft flight period, synoptic maps, satellite pictures, and plotted rawinsondes bracketing the flight period. Statistics indicated: (1) high skill in forecasting precipitation in 12 hour blocks out to 24 hours; (2) at 700 millibars wind direction is more predictable than wind speed; and (3) skill in delineating large from small precipitation amounts for the first 24 hours was good. Findings included: (1) moderate to high positive linear correlation between successive 3-hourly values of precipitable water vapor, summations of condensate supply rate, water vapor flux, temperature, and wind direction and speed; (2) better precipitation predictions for Blue Canyon through use of the past 3-hour value; (3) cooler temperatures and severely backed low level winds at Sheridan; and (4) poor predictability in moisture variables at Sheridan. (Schaefer-IPA)
W79-09421

RESERVATION DROUGHT IMPACT SURVEY,
South Dakota Univ., Vermillion. Business Research Bureau.
H. Wilde, and C. A. Kent.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-279 677, Price codes: A04 in paper copy, A01 in microfiche. Prepared for The United Sioux Tribes Development Corporation, January 12, 1977. 59 p, 4 fig, 29 tab.

Descriptors: *Droughts, *Environmental effects, *Water shortage, *Economic impact, *Sioux Reservations, Agriculture, Livestock, Precipitation(Atmospheric), Rainfall, South Dakota, Stock water, Productivity.

Drought impact data gathered from mail out questionnaires on seven Sioux Reservations is presented. The extent and magnitude of the drought is illustrated in tabular form listing Reservation locations, normal precipitation, and precipitation variance from normal for 1973 through 1976. For 1976 all of the Reservations experienced below average precipitation. The deficiency range was from almost 4 inches on the Cheyenne River to over 15 inches for the Sisseton-Wahpeton Sioux. Survey data were used to estimate current and projected economic losses due to the drought. Economic losses are reflected in crop losses, livestock losses, reduced rental incomes, and employment losses. Short, intermediate, and long term solutions to the drought impacts are discussed. Solutions outlined include: range conservation programs, water development programs, assistance to tribal governments, a moratorium on loan repayments, emergency employment programs, farm management programs, adjustments of lease terms, and additional funding programs. It is concluded that the drought has almost dealt a death blow to Reservation agriculture. Without substantial help, the potential which agriculture presents as a viable way of life for tribal members may be gone. (Seigler-IPA)
W79-09427

THE SCIENTIFIC PLANNING AND ORGANIZATION OF PRECIPITATION ENHANCEMENT EXPERIMENTS, WITH PARTICULAR ATTENTION TO AGRICULTURAL NEEDS,
World Meteorological Organization, Geneva (Switzerland).
Maybank, Jr.,
Publication No. 478, Technical Note No. 154, 1977. 104 p, 2 fig, 3 tab, 103 ref.

Descriptors: *Cloud seeding, *Weather modification, *Rainfall augmentation, *Agricultural engineering, *Precipitation(Atmospheric), Meteorology, Droughts, Storms, Rainfall, Water vapor, Climatology, Clouds, Crops, Winds, Hail.

The probable steps to be taken in a typical endeavor to ascertain the potential for rain augmentation in a region for which additional precipitation might be desired are outlined. The principles, past performance, and present problems connected with cloud seeding are summarized, and the steps to be taken in determining the specific needs for additional water are given. These steps are primarily related to agricultural usage as it is in this area that the greatest general potential for rain augmentation lies. Activities for determining the atmospheric water resources and potential for augmentation are discussed. It is generally necessary to investigate the potential for cloud seeding by means of a carefully designed experiment and to proceed to a full-scale rain-increase operation only if success can be demonstrated from the experiment. Various statistical designs are considered, and the problems that are met in the planning stages are discussed. Experimental details and costs for an idealized but reasonably typical cloud-seeding experiment are outlined. The evaluation steps that follow a completed experiment are described, together with consideration of further action if the results warrant future cloud-seeding operations. (Seigler-IPA)
W79-09434

SIERRA COOPERATIVE PILOT PROJECT, 1977-78 DATA INVENTORY, PROJECT SKYWATER.
Bureau of Reclamation, Denver, CO. Office of Atmospheric Resources Management.
For primary bibliographic entry see Field 7B.
W79-09438

PROJECT SKYWATER: SKYWATER CONFERENCE X REPORT. THE SIERRA COOPERATIVE PILOT PROJECT DESIGN,
North American Weather Consultants, Goleta, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-298 529, Price codes: A16 in paper copy, A01 in microfiche. Conference held June 22-23, 1978, South Lake Tahoe. 1979. 359 p, 83 fig, 25 tab, 1 append. 7-07-83-V0008.

Descriptors: *Weather modification, *Cloud seeding, *Project Skywater, Precipitation(Atmospheric), Cloud physics, Meteorology, Environmental effects, Rainfall-runoff relationships, Economic impact, Model studies, Social impact, Instrumentation, Water resources development.

The proceedings from the Skywater X Conference are reported. The conference was sponsored by the Bureau of Reclamation to discuss the status of preliminary studies and design work performed for the Sierra Cooperative Pilot Project (SCPP), a part of the Skywater Program. The overall project goal is the development of an effective weather modification technology, that is scientifically and socially acceptable, for precipitation management to serve a portion of the country's water needs. SCPP is studying the physical processes of precipitation formation to identify those conditions that provide the best potential for winter precipitation augmentation in the Sierra Nevada. Objectives include: improving current operational cloud seeding methods, transferring the techniques and results to concerned groups, and enhancing public confidence in their use. Topics of discussion at the conference included: environmental impact, the Sierra Ecology Project, preliminary project design, meteorological support measurements, and radar and aircraft data collection and analysis. Detailed presentation were given on the proposed design for SCPP continuation including extended areas of effect, tracers and contamination, and hypotheses. (Seigler-IPA)
W79-09474

OBSERVATIONS AND NUMERICAL SIMULATIONS OF PRECIPITATION MECHANISMS IN NATURAL AND SEEDED CONVECTIVE CLOUDS,
Chicago Univ., IL. Dept. of Geophysical Sciences.
L. D. Nelson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-298 301, Price codes: A10 in paper copy, A01 in microfiche. Technical Note No. 54, UCHI-CPL-79-54, March 1979. Doctoral Dissertation, 204 p, 55 fig, 8 tab, 61 ref.

Descriptors: *Mathematical models, *Precipitation(Atmospheric), *Cloud seeding, *Weather modification, Numerical analysis, Convection, Clouds, Rain, Hail, Meteorology, High Plains, Cloud physics, Climatology, Microphysics.

A numerical model was developed to assess the potential effects of artificial ice-phase seeding agents on precipitation development, rainfall, and hailfall in isolated summertime convective clouds. The model was successfully compared to radar and aircraft data of several natural clouds in differeent geographical locations. The model was specifically used to study seeding agents, rates, and evaluation techniques for potential use at the Bureau of Reclamation's High Plains Cooperative Program Miles City, Montana, field site. Various problems in technology transfer of seeding techniques from the High Plains region to other areas are discussed. The model was used to assess the effects of AgI and CO2 seeding on rainfall and hailfall processes and amounts at various sites around the world. Major model results indicate: (1) a strong coupling and feedback between ice-phase and liquid-phase microphysics, (2) natural clouds can be divided into two microphysical types, (3) these types tend to respond in opposite ways to attainable seeding rates of artificial ice-phase seeding agents, (4) rainfall and hailfall are generally positively coupled, (5) dry ice is the preferred agent for High Plain summertime seeding, and (6) hail suppression and rain augmentation techniques are not directly transferable from one area to another. (Seigler-IPA)
W79-09482

2C. Snow, Ice, and Frost

SYMPOSIUM ON THE PHYSICS AND CHEMISTRY OF ICE,

Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, 1978. 716 p. Glen, J. W., Adie, R. J., Johnson, D. M., Homer, D. R., and MacQueen, A. D., editors. Published by the International Glaciological Society, Cambridge (England).

Descriptors: *Ice, *Snow, *Crystallography, *Conferences, *Reviews, Physical properties, Physics, Chemistry, Electrical properties, Crystals, Thermal conductivity, Deformation, Nucleation, Mechanical properties, Frazil ice, Boundary processes, Ice-water interfaces, Creep, X-Ray diffraction, X-Ray analysis, Dielectric properties, Polycrystalline ice, Regelation.

The symposium objectives were to provide a review of progress in various branches of ice physics and chemistry since the last symposium (1972) and to report on recent and topical work. The broad subject areas covered included physical properties of ice, crystallography, ice structure, polycrystalline ice, snow, and electrical properties of ice. (See W79-09343 thru W79-09393) (Humphreys-ISWS)
W79-09342

THE DISTORTION OF A WATER MOLECULE IN ICE,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
For primary bibliographic entry see Field 1A.
W79-09343

CLATHRATE ICES--RECENT RESULTS,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
D. W. Davidson, and J. A. Ripmeester.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 33-49, 1978. 13 fig, 4 tab, 35 ref.

Descriptors: *Clathrates, *Ice, *Water structure, *Hydrates, Natural gas, Movement, Properties, Electrical properties, Crystals, Crystallography, Propane, Data collections, Water molecule, Gas hydrates, Methane, Ethane, Isobutane, Neopentane.

The last five years (1972-1977) have seen an increasing interest in clathrate ices as a result of the discovery of extensive deposits of natural gas hydrates in permafrost regions. Twenty-six new clathrate hydrates have been identified, mainly by NMR, including a tetragonal hydrate of dimethyl ether. N-butane and neopentane have been found to be enclathrated in natural gas hydrates, the former as a gauche conformer. As a result of their high symmetries, encaged neopentane, CF4, SF6, and SeF6 exhibit a resing apparent-phase-change effect in the temperature range of NMR line narrowing. There is increasing evidence that reorientational jumps of water molecules are more frequent than translational jumps in clathrate ices. This is certainly so for ethylene oxide-d4 and tetrahydrofuran-d8 hydrates, for which two regions of proton line narrowing and two T sub t rho minima have been observed. The reorientational motions of most guest molecules in structure II hydrates only become isotropic on a time scale long enough to permit the cage configurations to be averaged to 43m symmetry by reorientation of the water molecules. The orientations of the water molecules remain disordered to the lowest temperatures. (See also W79-09342) (Humphreys-ISWS)
W79-09344

X-RAY DETERMINATION OF THE STRUCTURE OF ICE IV,
California Inst. of Tech., Pasadena. Div. of Geological and Planetary Sciences.
H. Engelhardt, and B. Kamb.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 51-53, 1978. 2 fig, 1 tab, 4 ref.

Descriptors: *Ice, *X-ray analysis, *Hydrogen bonding, Structure, Molecular structure, Least squares method, X-rays, Bonding, Metastable ice, Ice IV, Water molecule.

Ice IV, a wholly metastable ice phase, has a structure based on a framework of tetrahedrally hydrogen-bonded water molecules in a rhombohedral unit cell. The structure involves two non-equivalent types of water molecules and four non-equivalent types of hydrogen bonds. A novel structural feature is a hydrogen bond that passes through the center of a 6-ring of water molecules and links non-adjacent structural layers. The bond network is proton-disordered, even after quenching. (See also W79-09342) (Humphreys-ISWS)
W79-09345

ORIGIN OF THE HIGH-FREQUENCY TRANSLATIONAL BANDS OF ICE I,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
D. D. Klug, and E. Whalley.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 55-63, 1978. 5 fig, 1 tab, 25 ref.

Descriptors: *Ice, *Structure, *Theoretical analysis, Hydrogen bonding, Vibrations, Mathematical models, Frequency, Refractivity, Anisotropy, Polarity, Analytical techniques, Ice I, High frequency.

The translational vibrations of hypothetical ordered forms of ice Ic and ice Ih have been predicted and correlated with the known spectra of the actual disordered phases. The TO-LO splittings were predicted by assuming that the changes of mean refractive indexes across the translational band is the same in all phases and equal to the known change for ice Ih. Both ordered phases were predicted to have LO components at c. 275 and c. 310/cm. These predicted bands are assumed to be related to the bands at the same frequencies in the disordered phases. These bands are, therefore, LO components corresponding to the TO translational vibrations. (See also W79-09342) (Humphreys-ISWS)
W79-09346

THE TRANSLATIONAL LATTICE-VIBRATION RAMAN SPECTRUM OF SINGLE-CRYSTAL ICE IH,
Centre Univ. de Savoie, Chambery (France). Lab. de Spectrometrie Raman-Laser.
P. Faure, and A. Chosson.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 65-72, 1978. 3 fig, 2 tab, 20 ref.

Descriptors: *Ice, *Hydrogen bonding, *Polarographic analysis, *Structure, Crystals, Spectrophotometry, Vibrations, Frequency, Analytical techniques, Measurement, Laboratory tests, Properties, Crystallography, Ice Ih, Monocrystals.

Presented were the Raman spectra in natural and polarized light of ice Ih monocrystals in the region of the translational frequencies. These spectra are of better quality and higher resolution than previous spectra from monocrystals, and they demonstrate the value of the investigation of single crystals by this technique, in spite of the proton disorder. In order to explain the observations, the authors used the model of simultaneous activity of the modes allowed in D sub sigma h symmetry and the modes allowed by the proton disorder. By analogy with the interpretation of the phenomena observed in ordered piezoelectric crystals, it was suggested that the existence of translation frequencies up to c. 320/cm is due to the splitting between transverse and longitudinal optical modes. On this basis, an initial simple dynamical model using only three parameters permits an interpretation of the Raman spectrum. The probable presence of directional effects in ice Ih argues in favor of the proposed explanation. (See also W79-09342) (Humphreys-ISWS)
W79-09347

CONFIGURATIONAL STATISTICS,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Physics.
J. F. Nagle.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 73-83, 1978. 40 ref. NSF DMR 72-03203-A02.

Descriptors: *Ice, *Electrical properties, *Statistical models, *Reviews, Mathematical models, Theoretical analysis, Statistics, Electrical conductance, Crystals, Molecular structure, Crystallography, Analytical techniques, Polarity, Dielectric constant, Polarization factor.

Theories of the dielectric constant in ice differ in three fundamentally different ways that are often confused with each other. First, there is the choice of interactions to include in the model, notably whether to try to include long-range dipolar interactions as in the Kirkwood theory or to include only the short-range ice-rule interactions. Second, there is the choice of the kind of statistical quantity calculated, e.g., the Kirkwood correlation factor g or the polarization factor G, which Stillinger and Cotter showed to be different. Finally, there is the choice of the kind of computational tool used, and in original papers this choice often obscures the first two differences. With these distinctions in mind, a review was given of current theoretical calculations of the dielectric constant and the residual entropy and how the different theories relate to each other and to experiments. (See also W79-09342) (Humphreys-ISWS)
W79-09348

VACANCIES IN PURE ICE STUDIED BY POSITRON ANNIHILATION TECHNIQUES,
Risoe National Lab., Roskilde (Denmark). Dept. of Chemistry.
O. E. Mogensen, and M. Eldrup.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 85-99, 1978. 5 fig, 27 ref.

Descriptors: *Ice, *Voids, *Crystals, *Electrical properties, Theoretical analysis, Analytical techniques, Mathematical models, Laboratory tests, Measurement, Methodology, Crystallography, Temperature, Hydrogen bonds, Monocrystals, Positron annihilation.

Positron annihilation techniques (PAT) were briefly discussed, and the information that may be obtained about the positronium (Ps) states was compared to that obtainable about the similar electron states. The behavior of Ps in monocrystals of pure light and heavy ice was studied at temperatures between -185 C and the melting point. Ps is very probably trapped in vacancies (i.e., missing water molecules) in ice. A vacancy formation energy of roughly 0.2-0.35 eV was derived in agreement with the value 0.28 + or - 0.07 eV obtained previously from studies of the annealing of irradiated ice. The vacancy concentration is at least a few parts per million at the melting point, i.e., roughly 10,000 times higher than normally assumed in the literature. The fact that the vacancy concentration is comparable to that of the hydrogen-bond defects will probably enforce a pronounced change in the 'hydrogen-bond-defects' theory of the electric properties of ice. (See also W79-09342) (Humphreys-ISWS)
W79-09349

VACANCIES IN HF-DOPED AND IN IRRADIATED ICE BY POSITRON ANNIHILATION TECHNIQUES,
Risoe National Lab., Roskilde (Denmark). Dept. of Chemistry.
M. Eldrup, O. E. Mogensen, and J. H. Bilgram.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16,

1977. Journal of Glaciology, Vol. 21, No. 85, p 101-113, 1978. 4 fig, 33 ref.

Descriptors: *Ice, *Voids, *Crystals, Radioisotopes, Irradiation, Analytical techniques, Laboratory tests, Measurement, Analysis, Cooling, Properties, Crystallography, Heating, Fluorides, Positron annihilation, Monocrystals, Doped ice, Polycrystalline ice, Hydrogen fluoride.

Positron annihilation techniques, which are specifically sensitive to vacancy-type defects, were used to study the effect on ice of irradiation and HF doping. Main conclusions are that immobile water-molecule vacancies can be created at low temperatures by either irradiation or HF doping. Upon heating, the vacancies become mobile at about 100 K. Some of them cluster into di- and multi-vacancies which grow in size with temperature up to at least 145 K. A vacancy migration energy of 0.34 + or - 0.07 eV is deduced, about three times higher than previously assumed. Possible mechanisms for vacancy formation by HF doping were discussed. Out-diffusion of HF is followed at -26 C over several weeks. The diffusion constant derived agrees within uncertainty (a factor of two) with the large value obtained by Haltenorth and Klinger. In particular, two results seem important for other parts of ice physics. One is that HF doping creates an appreciable increase in the vacancy concentration, the influence of which should be considered in models for other defects in ice. The other is that vacancies migrate at about 100 K, a fact which might be important for the interpretation of some of the many 'anomalous' effects observed in ice at about that temperature. (See also W79-09342) (Humphreys-ISWS)
W79-09350

INTERACTION OF POINT DEFECTS IN ICE,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festkorperphysik.
J. H. Bilgram, and H. Granicher.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 115-122, 1978. 6 ref.

Descriptors: *Ice, *Physical properties, *Crystals, Analytical techniques, Crystallography, Ions, Mathematical models, Analysis, Frequency, Properties, Structure, Chemistry, Temperature, Conductivity, Diffusion, Fluorides, Dissociation, Dielectric constants, Water molecule, Hydrogen fluoride.

The interaction of point defects in ice has been neglected for a long time. Experimental data obtained from dielectric measurements on HF-doped crystals stimulated a new evaluation of the possibility of an interaction between Bjerrum defects and ions. In a previous paper it has been shown that this leads us to assume the existence of aggregates of Bjerrum defects and ions. In this paper, these aggregates and Bjerrum defects were used to explain the dielectric properties of ice, especially the temperature dependence of the product of the high and low frequency conductivity. The interaction of Bjerrum defects and impurity molecules leads to a dependence of the concentration of Frenkel pairs on Bjerrum-defect concentration. At HF concentrations above the native Bjerrum-defect concentration, the formation of a Frenkel pair is enhanced. This leads to the fast out-diffusion which has been studied in highly doped crystals by means of NMR techniques. (See also W79-09342) (Humphreys-ISWS)
W79-09351

THEORETICAL MODELS FOR INTERPRETING THE DIELECTRIC BEHAVIOUR OF HF-DOPED ICE,
Handsworth Grammar School, Birmingham (England).
G. C. Camplin, J. W. Glen, and J. G. Paren.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 123-141, 1978. 8 fig, 6 tab, 19 ref.

Descriptors: *Ice, *Model studies, *Electrical properties, *Theoretical analysis, Crystals, Crystallography, Conductivity, Mathematical models, Temperature, Analytical techniques, Data collections, Analysis, Laboratory tests, Statistical methods, Conductivity, Fluorides, Ice dissociations, Monocrystals, Doped ice, Dielectric constants, Hydrogen fluoride.

To understand the recent dielectric measurements made on HF-doped ice single crystals requires a full knowledge of the concentration of electrical defects present in ice and their subsequent interactions. Previous interpretations of the behavior of HF-doped ice have concentrated upon specific features in isolation, whereas this paper presented analyses of a data set of 139 temperature and impurity combinations from 17 HF-doped ice single crystals. The interpretation of the behavior of these crystals is in terms of several possible theoretical models. All models are based upon the common assumptions that HF molecules enter the ice lattice substitutionally and that excess Bjerrum and ionic defects can be formed at the HF sites. They also use the theory of electrical conduction in ice and the defect equilibria analysis in ice. All models yield values for the concentration, mobility, energy of formation, and charges for the different types of electrical defect considered to be generated. Using the derived defect conductivities and the Jaccard theory of electrical conduction, the relaxation time of HF-doped ice was successfully predicted over a wide range of temperature and fluoride concentration. (See also W79-09342) (Humphreys-ISWS)
W79-09352

ELECTRICAL CONDUCTIVITY AND RELAXATION IN ICE CRYSTALS WITH KNOWN IMPURITY CONTENT,
New Mexico Inst. of Mining and Technology, Socorro.
G. W. Gross, I. C. Hayslip, and R. N. Hoy.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 143-160, 1978. 15 fig, 1 tab, 35 ref. ONR NR082-094. NSF ATM 74-19379.

Descriptors: *Ice, *Electrical properties, *Crystallography, *Model studies, Crystals, Conductivity, Polarity, Laboratory tests, Electrical conductance, Chlorides, Analysis, Dispersion, Measurement, Analytical techniques, Methodology, Monocrystals.

Three-terminal dielectric bridge measurements (in the range 20 Hz to 100 kHz between -5 C and -90 to -120 C) were made of ice doped with (1) conductivity-enhancing ionic impurities (HCl, HF, NaCl, KF, NH4F) and (2) conductivity-depressing solutes (NH4OH, NH4 Cl, NH5CO3, NaHCO3). Blocking electrodes were used for the first group. The true ice parameters were extracted from linearized plots of the Debye equations. Chlorides and fluorides showed very similar characteristics in their spectra and static conductivity. The results suggested that static conductivity is controlled by extrinsic protons. On the other hand, bases, or solutes that impart a positive freezing potential to the ice, suppress extrinsic protons. In this case, the static conductivity was not, or only weakly, temperature dependent and lower than in the first group. A conductivity cross-over was observed in neither case. The dielectric conductivity contribution is strongly dependent on impurity concentration but apparently less affected than the static conductivity by the nature of the solute. The principal relaxation time is reduced by most solutes, exceptions are pure (bicarbonate-free) bases, sodium bicarbonate, and carbon dioxide. (See also W79-09342) (Humphreys-ISWS)
W79-09353

EFFECT OF PRESSURE ON THE DIELECTRIC PROPERTIES OF ICE IH SINGLE CRYSTALS DOPED WITH NH3 AND HF,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festokoerperphysik.
M. Hubmann.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 161-172, 1978. 5 fig, 23 ref.

Descriptors: *Ice, *Electrical properties, *Crystals, *Crystallography, Laboratory tests, Conductivity, Pressure, Electrical conductance, Ammonia, Effects, Sampling, Testing procedures, Measurement, Electrical impedance, Temperature, Mathematical models, Chemistry, Dispersion, Analysis, Analytical techniques, Monocrystals, Hydrogen fluoride, Dielectric constant, Doped ice.

This paper described measurements of the dielectric constant and of the conductivity on pure and doped ice single crystals subjected to hydrostatic pressure. The dopants used were NH3 or HF. The pressure and temperature ranges covered were 1 to 1,500 bar and -15 to -60 C. The activation volumes for the orientational and the ionic contribution to the conductivity could be determined. A definitive interpretation was not possible because many questions concerning the formation of the defects are still open. In addition to the main subject, some new data from conductivity measurements on NH3-doped single crystals at atmospheric pressure were presented. (See also W79-09342) (Humphreys-ISWS)
W79-09354

ELECTRICAL BEHAVIOUR OF FINELY DIVIDED ICE,
British Antarctic Survey, Cambridge (England).
J. G. Paren, and J. W. Glen.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 173-191, 1978. 8 fig, 5 tab, 22 ref.

Descriptors: *Ice, *Electrical properties, *Model studies, *Crystals, Mathematical models, Crystallography, Sampling, Laboratory tests, Carbon dioxide, Analysis, Analytical techniques, Adsorption, Conductivity, Effects, Dispersion, Data collections, Temperature, Frequency, Monocrystals, Finely divided ice, Polar ice.

The electrical behavior of ice which has been finely ground and compressed was investigated during ageing in air and over a range of temperatures. The dielectric behavior may be accurately represented as the sum of two elliptical relaxation spectra. The behavior eventually stabilizes with similar activation energies for the mean relaxation time of each spectrum c. 0.25 eV, and the ratio of the relaxation times is 10 in samples of density c. 0.42 Mg/cu m. Arguments were presented on whether the higher-frequency dispersion is a consequence of the heterogeneous nature of the samples or is a bulk relaxation process. The similarities between the behavior of such finely ground ice and of deposited snow and polar glacier ice were discussed. The extent to which the results may be attributed to surface adsorption of CO2 was examined by reference to measurements of the CO2 content of finely divided ice and ice from polar regions. Measurements are needed of specific surface area and of CO2 levels in ice, snow, and firn to explore the extent to which the present scatter in CO2 data is due to experimental uncertainties. Above all, electrical studies should be undertaken on monocrystals of ice containing carbonic acid and on finely-divided doped ice. (See also W79-09342) (Humphreys-ISWS)
W79-09355

THE ELECTRICAL PROPERTIES OF ICE SURFACES,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
N. Maeno, and H. Nishimura.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 193-205, 1978. 9 fig, 15 ref.

Descriptors: *Ice, *Electrical properties, *Crystallography, *Boundary processes, Conductivity,

Surfaces, Boundaries(Surfaces), Temperature, Electric fields, Laboratory tests, Testing procedures, Effects, Sublimation, Fluorides, Analysis, Analytical techniques, Monocrystals, Monocrystalline ice, Surface conductivity, Hydrogen fluoride.

The surface conductivity of monocrystalline ice was measured as a function of temperature, impurity concentration, field-strength, and other variables. At temperatures below about -6 C, the surface conductivity was found to follow the Arrhenius equation with an activation energy of 33 + or - 2 kcal/mol (1.43 + or - 0.09 eV). Small amounts of impurities contained within the ice increased the surface conductivity and decreased the activation energy: for HF-doped ice the activation energy was reduced to 10.0 kcal/mol (0-44 eV). Mechanical treatment of the ice surface increased the surface conduction. At temperatures above about -6 C the surface conductivity increased more rapidly with the rise in temperature; this is explained in terms of the appearance and development of a quasi-liquid layer on the ice surface. The electrical behavior of sublimed ice surfaces was found to vary at a temperature around -9 C. At higher temperatures a sharp, instantaneous current increase was observed as evacuation began; this was considered to be caused by the formation of ionic states due to the rapid evaporation of quasi-liquid layers. It was concluded that the temperature above which the ice surface was covered with a quasi-liquid layer lay in the range -6 to -9 C. (See also W79-09342) (Humphreys-ISWS)
W79-09356

DIELECTRIC PROPERTIES OF DISLOCATION-FREE ICE,
Army Terrestrial Sciences Center, Hanover, NH.
K. Itagaki.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 207-217, 1978. 9 fig, 1 tab, 20 ref, 1 append.

Descriptors: *Ice, *Electrical properties, *Crystals, *Boundary processes, Laboratory tests, Testing procedures, Frost, Data collections, Boundaries(Surfaces), Analysis, Analytical techniques, Frequency, Surfaces, Conductance, Electric fields, Monocrystals, Dielectric constants.

Dielectric properties of dislocation-free hoar-frost ice crystals were measured in the audio-frequency range. Anomalously small relaxation strength was found in the dislocation-free area of the crystal samples, while dislocations deliberately introduced by scratching the samples drastically modified the relaxation strength. Since measurements made in the area of high dislocation density indicated normal behavior, electrically charged dislocations are considered to be the source of the normally observed dielectric relaxation. (See also W79-09342) (Humphreys-ISWS)
W79-09357

MEASUREMENTS OF THE ELECTRICAL PROPERTIES OF ICE IH SINGLE CRYSTALS BY ADMITTANCE AND THERMALLY STIMULATED DEPOLARIZATION TECHNIQUES,
Modena Univ. (Italy).
A. Loria, E. Mazzega, U. Del Pennino, and G. Andreotti.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 219-230, 1978. 5 fig, 21 ref.

Descriptors: *Ice, *Electrical properties, *Crystals, *Boundaries(Surfaces), Laboratory tests, Analytical techniques, Analysis, Mathematical models, Conductivity, Testing procedures, Electric fields, Electric currents, Measurements, Temperature, Frequency, Ice Ih, Monocrystals, Monocrystalline ice.

Ice Ih single crystals were investigated by complex admittance and thermally stimulated depolarization (TSD) techniques in the relaxation-time ranges 0.00001 to 10s and 10 to 10,000s, respectively. The relaxation spectrum was resolved, and three components were studied. Second-order kinetics had to be assumed for two of the TSD spectra to obtain Arrhenius-type relaxation times. The 'Debye spectrum' had an activation energy for the relaxation time of 0.64 eV at the high temperatures, and its dielectric strength revealed a possible defect crossover at T = 190 K. Far below this temperature, the activation energy was 0.38 eV, that is about half of that necessary for a pair of ion defects to form. In comparison with the results of other authors, a lower concentration of ionic defects, or possibly of Bjerrum-ion aggregates, was deduced to occur in these crystals. Inert-gas host molecules were proposed as a possible origin of the two other spectra, having relaxation times shorter than the 'Debye spectrum' and energies of 0.33 eV and 0.37 eV. Moreover the 0.33 eV spectrum, whose dielectric strength appears at a temperature below T, might alternatively be related to the cross-over of the 'Debye spectrum'. The TSD technique seems to give results similar to those obtained by dielectric relaxation measurements, provided that, in certain cases, one assumes a depolarization kinetics different from that shown to be valid at the higher temperatures in frequency-dependent measurements. Further experimental investigations and a careful analysis of the thermally stimulated depolarization kinetics in real ice crystals will be necessary to clarify this discrepancy. (See also W79-09342) (Humphreys-ISWS)
W79-09358

INELASTIC NEUTRON SCATTERING FROM ICE AND OTHER PROTON-CONTAINING SUBSTANCES,
Institut Max von Laue-Paul Langevin, Grenoble (France). Centre de Tri.
B. Dorner.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 231-240, 1978. 7 fig, 23 ref.

Descriptors: *Ice, *Neutron activation analysis, *Crystals, Analysis, Analytical techniques, Diffusion, Theoretical analysis, Mathematical models, Structure, Laboratory tests, Measurement, *Neutron scattering, Ice Ih, Protons.

A brief introduction to neutron scattering was given, with special emphasis on the difference between coherent and incoherent contributions. The report of recent work on ice contained the determination and verification of some phonon dispersion curves, and it outlined the state of the art on diffuse scattering due to the proton disorder. Results on 'two-dimensional ice' in copper formate tetrahydrate are of great interest as this system exhibits a phase transformation below which the protons are ordered. The study of rotational diffusion and of the tunnel splitting of the rotational ground state of molecules which contain protons was discussed in some detail. These investigations are now possible with very high energy resolution. Delta E approximately 5 x 10 to the minus 8th power eV (0.0004/cm or 12 MHz). (See also W79-09342) (Humphreys-ISWS)
W79-09359

THERMAL CONDUCTIVITY OF ICE IN THE TEMPERATURE RANGE 0.5 TO 5.0 K,
CEA Centre d'Etudes Nucleaires de Grenoble (France). Service des Basses Temperatures.
M. Varrot, G. Rochas, and J. Klinger.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 241-245, 1978. 2 fig, 3 ref.

Descriptors: *Ice, *Thermal conductivity, *Laboratory tests, Crystals, Temperature, Measurement, Mathematical models, Analysis, Analytical techniques, Thermal properties, Methodology, Testing procedures, Heat flow.

A method was described for measuring the thermal conductivity of ice in the temperature range from 0.5 to 5.0 K using a 3He apparatus. The results from the first experiments were not too far from the theoretical law for the low-temperature thermal conductivity of ice lambda = 0.42 Tau. Measurements at still lower temperatures are necessary to confirm the results. (See also W79-09342) (Humphreys-ISWS)
W79-09360

RADIATION DAMAGE IN ICE AT LOW TEMPERATURES STUDIED BY PROTON CHANNELLING,
Neuchatel Univ. (Switzerland). Inst. de Physique.
I. Golecki, and C. Jaccard.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 247-258, 1978. 4 fig, 25 ref.

Descriptors: *Ice, *Radiation, *Crystallography, Laboratory tests, Temperature, Irradiation, Testing procedures, Crystals, Measurement, Structure, Analysis, Analytical techniques, Proton channelling, Low temperature, Monocrystals.

In the reported study, 100 keV protons with fluxes between 3 x 10 to the 15th power and 3 x 10 to the 16th power/sq m/s and in doses up to 4 x 10 to the 20th power/sq m were used in ice between -191 C and -87 C to create damage and to analyze it. The Rutherford backscattering minimum yield along the c-axis (about 0.05 in good monocrystals) increases up to unity with the dose, according to a function which can be scaled by a 0.17 + or - 0.04 eV above -185 C). Higher flux produces more damage above -180 C, but less below. A beam in a random direction is more efficient below -180 C, but less at higher temperature than an aligned beam. Beam-induced reordering was observed at definite temperatures and doses. The damage was shown to be due to energy loss by electronic excitations, which decay and produce disordered molecule clusters, mainly by incoherent aggregation of vacancies and interstitials. (See also W79-09342) (Humphreys-ISWS)
W79-09361

THE ORIENTATION POLARIZATION IN HEXAGONAL ICE PARALLEL AND PERPENDICULAR TO THE C-AXIS,
Department of Fisheries and Environment, Ottawa (Ontario). Inland Waters Directorate.
G. P. Johari, and S. J. Jones.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 259-276, 1978. 9 fig, 3 tab, 39 ref.

Descriptors: *Ice, *Polarity, *Electrical properties, *Crystallography, Electric fields, Frequency, Energy, Crystals, Laboratory tests, Testing procedures, Temperature, Measurement, Sampling, Instrumentation, Aging(Physical), Analytical techniques, Analysis, Data collections, Monocrystals, Permittivity, Dielectric constants.

The relative permittivity and loss of zone-refined single crystals of hexagonal ice were measured in the temperature range 200-271 K and frequency range 0.5 Hz-0.2 MHz, using brass, stainless steel, and gold-foil electrodes. The c-axis of the crystal was oriented parallel to the electric field in 14 samples, and perpendicular to the field in 8 samples. The equilibrium relative permittivity of orientation polarization, epsilon sub o, parallel and perpendicular to the c-axis, is 96.5 + or - 1, and the average relaxation time tau is 36 microseconds at 265.5 + or - 0.5 K; epsilon sub o = 124 + or - 1.5 and tau = 30 ms, at 210 K. The magnitude of the orientation polarization obeys the Curie-Weiss equation with T sub o = 15 + or - 2 K for both orientations. These values are in contrast with the c. 17% difference in epsilon sub o for the two orientations reported in the literature. The extrapolated limiting high-frequency relative permittivity epsilon sub infinity, measured for both the orientations, is indistinguishable within 0.5%. The logarithmic plot of the product of tau and temperature against the reciprocal temperature is linear in the range 210-271 K and gives an activation energy

and a pre-exponential factor of 51 + or - 2 kJ/mol and 0.93 + or - 0.22 ps K respectively, for both the orientations of the c-axis with respect to the electric field. The decrease in activation energy which has been reported to occur in polycrystalline ice and in single crystal ice near 230 K is not found until a temperature of 210 K. Single crystals of ice stored in the dielectric cell, after the completion of measurements, for periods ranging from 1-11 weeks at 253 + or - 2 K showed no change in their epsilon sub o, tau, epsilon sub infinity that could be attributed to the effect of ageing on the orientation polarization. (See also W79-09342) (Humphreys-ISWS)
W79-09362

THE INFLUENCE OF THE RATE OF DEFORMATION ON THE ELECTRICAL PROPERTIES OF ICE MONOCRYSTALS,
Stuttgart Univ. (Germany, F.R.). Physikalisches Inst.
G. Noll.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 277-289, 1978. 8 fig, 1 tab, 19 ref.

Descriptors: *Ice, *Electrical properties, *Mechanical properties, *Crystallography, Deformation, Plastic deformation, Conductivity, Electrical conductance, Electric fields, Shear, Strain, Rates, Analysis, Analytical techniques, Compressibility, Aging(Physical), Laboratory tests, Instrumentation, Testing procedures, Measurement, Monocrystals, Dielectric constants, Permittivity.

The influence of plastic deformation on the electrical properties of ice monocrystals was measured in the frequency range 0.01 to 100,000 Hz as a function of strain-rate and strain. The crystals were tested mainly under uniaxial compression, their orientation being for glide in the basal glide system (0001) (1120). The resolved shear strain-rate ranged from 0.00002 to 0.001/s, and the resolved shear strain ranged from 3 to 60%. Transient as well as bridge methods were used for the electrical measurements before, during, and after the deformation. Plastic deformation reduces the electrical conductivity in the space-charge dispersion range. The decrease depends strongly on the strain-rate; the size of the strain has practically no influence. After the end of the deformation, recovery processes were observed, which restored the original conductivity if the total strain was small. Rapid and large deformations, however, leave permanent changes. The changes of the d.c. conductivity and of the dispersion strength in the space-charge region were discussed and attributed to the increase of the dislocation density and the change of character of the dislocation network. (See also W79-09342) (Humphreys-ISWS)
W79-09363

CO2 IN NATURAL ICE,
Bern Univ. (Switzerland). Physikalisches Inst.
B. Stauffer, and W. Berner.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 291-300, 1978. 3 fig, 5 tab, 18 ref.

Descriptors: *Ice, *Carbon dioxide, *Snow, *Gases, Laboratory tests, Testing procedures, Instrumentation, Measurement, Hail, Alkalinity, Hydrogen ion concentration, Analysis, Analytical techniques, Data collections, Dissolved gases.

Natural ice contains approximately 100 ppm (by weight) of enclosed air. This air is mainly located in bubbles. Carbon dioxide is an exception. The fraction of CO2 present in bubbles was estimated to be only about 20%. The remaining part is dissolved in the ice. Measurements of the CO2 content of ice samples from temperate and cold glacier ice as well as of freshly fallen snow and of a laboratory-grown single crystal were presented. It is probable that a local equilibrium is reached between the CO2 dissolved in the ice and the CO2 of the surroundings and of the air bubbles. The CO2 content of ancient air is directly preserved neither in the total CO2 concentration nor in the CO2 concentration in the bubbles. Possibly the CO2 content of ancient air may at least be estimated if the solubility and the diffusion constant of CO2 in ice are known as a function of temperature. (See also W79-09342) (Humphreys-ISWS)
W79-09364

THE RADIO-FREQUENCY BIREFRINGENCE OF POLAR ICE,
Scott Polar Research Inst., Cambridge (England).
N. D. Hargreaves.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 301-313, 1978. 4 fig, 1 tab, 32 ref, 1 append.

Descriptors: *Ice, *Electrical properties, *Optical properties, *Crystallography, Radio waves, On-site investigations, Polar regions, Anisotropy, Theoretical analysis, Mathematical models, Analytical techniques, Analysis, Electric fields, On-site tests, Monocrystals, Dielectric constants, Birefringence, Ice fabrics.

Radio-echo observations have shown that polar ice in situ is birefringent. The most likely explanation of the birefringence is an anisotropy in the radio-frequency dielectric constant of the ice single crystal, combined with the ordering of the orientations of the ice crystals in polar ice. It is possible to calculate the birefringence of ice which has a distribution of crystal orientations using a technique similar to that used to derive the dielectric properties of heterogeneous media. The experimentally observed birefringence may then be shown to be consistent with the crystal orientation fabric at the site of the observations if the anisotropy of the dielectric constant is slightly less than 1%, that is, slightly less than the accuracy of the laboratory measurements which have failed to detect any anisotropy. Further experimental observations might be used to obtain information on not only the level of anisotropy of the single crystal but also on the crystal orientation fabric of the ice. (See also W79-09342) (Humphreys-ISWS)
W79-09365

DIELECTRIC PERMITTIVITY OF GLACIER ICE MEASURED IN SITU BY RADAR WIDE-ANGLE REFLECTION,
Wisconsin Univ.-Madison. Geophysical and Polar Research Center.
K. C. Jezek, J. W. Clough, C. R. Bentley, and S. Shabtaie.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 315-329, 1978. 11 fig, 2 tab, 28 ref. NSF DPP72-05802.

Descriptors: *Ice, *Electrical properties, *On-site investigations, *Antarctic, Electric fields, On-site tests, Sounding, Frequency, Reflectivity, Radio waves, Radar, Remote sensing, Analytical techniques, Analysis, Velocity, Glaciers, Permittivity, Radio-echo sounding, Dielectric constants.

Values of relative permittivity measured by the wide-angle reflection technique on the Ross Ice Shelf show substantial variations between sites, from 3.09 to 2.89, with estimated errors of + or - 0.03. The largest values, closest to those normally measured in the laboratory, are found nearest to the grounded ice sheet; values decrease generally in the direction of thinner ice that has been longer on the ice shelf. It is believed that the variation reflects some real physical phenomenon in the ice shelf, either a true variation in the permittivity of the ice or a complication of the ray-path geometry, but it is not possible to offer a satisfactory model at present. (See also W79-09342) (Humphreys-ISWS)
W79-09366

THE ACTIVATION ENERGIES OF TEMPERATE SNOW SAMPLES,
Saint Andrews Univ. (Scotland). School of Physical Sciences.
L. T. Traub, and P. W. F. Gribbon.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 331-339, 1978. 3 fig, 1 tab, 11 ref.

Descriptors: *Snow, *Ice, *Activation energy, *Electrical properties, Crystallography, Conductivity, Electrical conductance, Electric fields, Frequency, Laboratory tests, Analysis, Measurement, Temperature, Permittivity.

The temperature dependence of the high-frequency conductivity of snow was studied for 8 samples in the range -10 C to -80 C. The activation energies for granular snow varied from 0.60 eV at temperatures down to -25 C to 0.24 eV at temperatures below -25 C, and for dry snow from 0.42 eV to 0.18 eV in the same temperature ranges. Dry snow samples had higher conductivities and lower activation energies than granular icy samples throughout the complete temperature range. Volume and surface conduction processes were operative. At the higher temperatures above -25 C, volume conduction was attributed to Bjerrum defect migration, while at lower temperatures, Bjerrum conduction was replaced by ionic-defect conduction. Granular samples which had experienced melting and refreezing on the surface of the crystals had a structural change which decreased the ionic-defect density at the surface and lowered the sample conductivity. Above -25 C, the activation energies for granular icy snow were consistent with those for temperate glacier ice and for laboratory single and polycrystalline ice samples, but were not in agreement with those of either polar snow or ice. Below -25 C, the activation energies for granular snow were consistent with those for temperate glacier ice containing impurities and for polar snow and ice. Fresh, dry, temperate snow samples had lower activation energies than in situ polar snow. (See also W79-09342) (Humphreys-ISWS)
W79-09367

THE CORE STRUCTURE AND THE MOBILITY OF DISLOCATIONS IN ICE,
Birmingham Univ. (England). Dept. of Physics.
R. W. Whitworth.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 341-359, 1978. 8 fig, 41 ref.

Descriptors: *Ice, *Molecular structure, *Model studies, *Reviews, Crystallography, Structure, Movement, Velocity, Analytical techniques, Theoretical analysis, Ice Ih, Ice dislocations, Water molecules, Ice mobility.

The evidence concerning the velocity of glide of dislocations on the (0001) plane of ice Ih was reviewed and related to atomic processes occurring within or near the dislocation core. The velocity is directly proportional to stress at low stress, with a value of the order of 500 Burgers vectors per second at -18 C and a stress of 100,000 N/sq m. The usual idea of a dislocation core is that it is 'crystalline' in the sense that the linkages between molecules are as far as possible the same as those in the normal lattice. For such a model, the disorder of protons presents an obstacle to dislocation movement, and recent theories predict that dislocations should not be able to glide as fast as they are observed to do. Various ways of avoiding this difficulty within the context of a crystalline core were discussed, but none seems likely to be successful. An alternative model is that the core is 'non-crystalline', with a disordered arrangement of mobile molecules within it. The movement of such dislocations should not be seriously impeded by proton disorder. Dislocation mobility would then be limited, at least in part, by an elastic loss due to the stress-induced order of protons in the surrounding lattice. (See also W79-09342) (Humphreys-ISWS)
W79-09368

COOPERATIVE MOVEMENT OF H2O MOLECULES AND DYNAMIC BEHAVIOUR OF DISLOCATIONS IN ICE IH,
Institut National des Sciences Appliquees, Lyon (France). Groupe d'Etudes de Metallurgie Physique et de Physique des Materiaux.
J. Perez, C. Mai, and R. Vassoille.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 361-374, 1978. 5 fig, 24 ref.

Descriptors: *Ice, *Model studies, *Crystallography, *Dynamics, Mathematical models, Analytical techniques, Theoretical analysis, Analysis, Movement, Velocity, Structure, Shear stress, Temperature, Equations, Ice Ih, Ice dislocations, Water molecules.

A new model of dislocations glide in ice Ih was proposed. In developing this model, certain assumptions were made: (1) dislocations have a noncrystalline extended core, and (2) transitions occur through cooperative movements of H2O molecules in the core of dislocations. A relation between the velocity of linear defects and shear stress tau or temperature, T, was obtained. This relation showed that velocity varies linearly with tau at low values of tau and/or T but varies more rapidly at higher stresses; this non-linearity is more pronounced the higher the temperature. Such results are in agreement with experimental data. (See also W79-09342) (Humphreys-ISWS)
W79-09369

INELASTIC BEHAVIOUR OF ICE IH SINGLE CRYSTALS IN THE LOW-FREQUENCY RANGE DUE TO DISLOCATIONS,
Institut National des Sciences Appliques, Lyon (France). Groupe d'Etudes de Metallurgie Physique et de Physique des Materiaux.
R. Vassoille, C. Mai, and J. Perez.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 375-384, 1978. 8 fig, 1 tab, 18 ref.

Descriptors: *Ice, *Deformation, *Crystallography, *Model studies, Mechanical properties, Laboratory tests, Testing procedures, Movement, Friction, Methodology, Analysis, Analytical techniques, Temperature, Strain, Velocity, Plastic deformation, Shear stress, Dynamics, Ice Ih, Monocrystals, Ice dislocations, Torsion, Internal friction.

The inelastic behavior of ice Ih single crystals was investigated with an inverted torsional pendulum in the low-frequency range. Three features were distinguished: (1) a relaxation peak previously observed in the higher-frequency range; (2) an internal friction increasing with temperature in the high-temperature range (230-273 K); and (3) within this high-temperature range, internal friction becomes amplitude dependent, and this dependence becomes greater the greater the temperature. In this case, the internal friction was interpreted in terms of movements of dislocations. Hence, the experimental results were interpreted with a model of internal friction based on an empirical relation for the velocity of dislocations. This model of internal friction is in fair agreement with experimental data. It is possible then to get an estimate of dislocation density. Hence, it was shown that internal friction experiments can be useful in the study of the plastic behavior of ice single crystals. (See also W79-09342) (Humphreys-ISWS)
W79-09370

OBSERVATION OF BASAL DISLOCATIONS IN ICE BY ETCHING AND REPLICATING,
National Research Council of Canada, Ottawa (Ontario). Div. of Building Research.
N. K. Sinha.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 385-395, 1978. 11 fig, 20 ref.

Descriptors: *Ice, *Crystallography, *Sampling, *Boundaries(Surfaces), Marking techniques, Methodology, Testing procedures, Instrumentation, Analytical techniques, Measurement, Polycrystalline ice, Ice dislocations, Etching, Replicating.

A method was described for preparing the surface of ice and for forming etch pits on the prismatic surfaces with whisker replicas that correspond to basal dislocations. The technique removes the ambiguity sometimes associated with etch pits and dislocations, and it allows direct observation of dislocation glide, pile-up against barriers, and other features in deformed ice. The ability to replicate minute changes in the microstructure of ice opens up further possibilities for the application of the technique; for example, examination of grain-boundary sliding, dislocation multiplications, voids, and cracks in polycrystalline ice produced during creep. (See also W79-09342) (Humphreys-ISWS)
W79-09371

X-RAY TOPOGRAPHIC STUDIES OF DISLOCATIONS IN VAPOR-GROWN ICE CRYSTALS,
Nevada Univ. System, Reno. Desert Research Inst.
C. V. McKnight, and J. Hallett.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 397-407, 1978. 9 fig, 21 ref.

Descriptors: *Ice, *Crystal growth, *Crystallography, Crystals, Methodology, Laboratory tests, Analytical techniques, Instrumentation, Topography, Shape, Freezing, Temperature, Structure, X-ray analysis, Surfaces, Ice dislocations, Vapor grown ice.

Ice crystals grown from the vapor under controlled conditions were examined by x-ray topography. Plates grown in the region -1.5 C to -3 C and at -15 C near water saturation were often free of defects, as were plates grown at smaller supersaturations (1.5% at -3 C, 6% at -15 C). It was inferred from these observations that growth was occurring by two-dimensional nucleation on the prism plane. It was suggested that multilayer adsorption on the crystal surface was responsible for growth at the low values of supersaturation, compared with higher values predicted by the Burton-Cabrera-Frank theory. Ice crystals dependent on dislocations for growth could only occur at supersaturations lower than these values. The crystal habit was interpreted as being dependent on differential two-dimensional nucleation on prism or basal faces. Rib structure is often associated with dislocation loops; stacking faults were evident in some crystals. (See also W79-09342) (Humphreys-ISWS)
W79-09372

STUDIES OF CRYSTAL IMPERFECTIONS IN ICE WITH REFERENCE TO THE GROWTH PROCESS BY THE USE OF X-RAY DIFFRACTION TOPOGRAPHY AND DIVERGENT LAUE METHOD,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
Y. Mizuno.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 409-418, 1978. 9 fig, 14 ref.

Descriptors: *Ice, *Crystal growth, *X-ray diffraction, *Crystallography, Topography, Shape, Structure, Laboratory tests, Testing procedures, Methodology, Analytical techniques, Frost, Glaciers, Analysis, Ice dislocations, X-ray topographs, Crystal imperfections.

This paper presented studies on crystal imperfections, including basal and non-basal dislocations, small-angle grain boundaries, stacking faults, and dislocation networks in ice using both x-ray diffraction and Laue techniques; these studies examined the growth process or origin of the ice, i.e., ice from glaciers, ice grown from the melt, or ice formed by sublimation. Several hoar crystals were found to be perfect, dislocation-free crystals. This may be due to their very slow growth rate. Dislocations and Shockley-type stacking faults were observed in some crystals. Dislocation density of a hoar crystal is very large at the point at which it started to grow, but away from this region, the density becomes so small that no dislocation can be seen. The arrangement and structure of dislocations around vapor figures were also studied by means of x-ray diffraction topography. It was found that the dislocation density is high along x-ray diffraction topography. It was found that the dislocation density is high along the periphery of the vapor hexagon and that the great majority of dislocations within the hexagon are running from its center towards the vertices or sides of the hexagon. Long screw dislocations with Burgers vector c (0001) were observed in a tabular ice, which was formed artificially at a very slight degree of supercooling. The behavior of dislocations in ice subjected to a tensile stress was studied by the use of the divergent x-ray techniques which gives both enlarged Laue spots and a transmission pattern in the same photograph. Use of the divergent Laue method indicated that an ice crystal could attain a greater degree of perfection as a result of the movement of pre-existing dislocations caused by a small deformation at low stress. (See also W79-09342) (Humphreys-ISWS)
W79-09373

A DEFORMATION MECHANISM MAP OF ICE,
Hokkaido Univ., Sapporo (Japan). Dept. of Applied Physics.
H. Shoji, and A. Higashi.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 419-427, 1978. 1 fig, 1 tab, 22 ref, 1 append.

Descriptors: *Ice, *Deformation, *Model studies, *Crystallography, Mapping, Rates, Activation energy, Mathematical models, Strain, Shear stress, Analytical techniques, Temperature, Movement, Creep, Mechanical properties, Ice dislocations, Polycrystalline ice.

A deformation mechanism map for pure polycrystalline ice of 2 mm grain diameter was constructed. New sub-regions in the dislocation glide region were proposed: dislocation glide with crack formation, dislocation creep, and fracture at high stresses above about 1 MPa. The boundary between the dislocation creep and DGC regions was determined by the onset of cleavage cracks due to piled-up dislocations near grain boundaries. The fracture region is that area of the map where fracture occurs readily when the ice is subjected to a rapid deformation rate exceeding 0.001/s. Experimental results of the stress dependence of the compressive deformation rate of polycrystalline ice were compared with the map. The effect of changes in the creep activation energy near the melting point was discussed together with those of other factors. At higher stress above 10 MPa, a pressure-melting region should be incorporated in the map, but it was not included. The map proposed was constructed for uniaxial compressive stress without any superimposed hydrostatic pressure. (See also W79-09342) (Humphreys-ISWS)
W79-09374

THE CREEP ACTIVATION ENERGIES OF ICE,
Birmingham (England). Dept. of Physics.
D. R. Homer, and J. W. Glen.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 429-444, 1978. 6 fig, 4 tab, 43 ref.

Descriptors: *Ice, *Creep, *Activation energy, *Crystallography, Laboratory tests, Measurement, Movement, Strain, Rates, Crystal growth, Temperature, Data collections, Testing procedures, Methodology, Mechanical properties, Analytical techniques, Analysis, Monocrystals, Bicrystals, Polycrystals.

Monocrystals and bicrystals of ice were creep tested at temperatures between -4 and -30 C. The bicrystals had a single grain boundary running parallel to the tensile axis; this configuration inhibited grain-boundary slip between the two grains. The creep tests, which were carried out at constant stress alpha and temperature T, yielded data of strain epsilon for time elapsed since the start of the test. These data showed accelerating creep for both monocrystals and bicrystals at all strain levels. Strain-rates were derived at strains of 0.01, 0.05, and 0.10, and these rates were fitted to the expression where epsilon varies as (alpha to the n power)exp(-E/kT), where k is Boltzmann's constant and E is the creep activation energy. Derived values of n were 1.9 for monocrystals and 2.9 for bicrystals. The creep activation energy was found to be 78 kJ/mol for monocrystals and 75 kJ/mol for bicrystals. The processes of creep deformation in mono-, bi-, and polycrystals were discussed. (See also W79-09342) (Humphreys-ISWS)
W79-09375

DEFORMATION OF ICE SINGLE CRYSTALS CLOSE TO THE MELTING POINT,
Department of Fisheries and Environment, Ottawa (Ontario). Inland Waters Directorate.
S. J. Jones, and J.-G. Brunet.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 445-455, 1978. 13 fig, 11 ref.

Descriptors: *Ice, *Deformation, *Crystals, *Laboratory tests, Strain, Stress, Temperature, Testing procedures, Mechanical properties, Compressibility, Activation energy, Crystallography, Rates, Data collections, Monocrystals.

Constant strain-rate compression tests on ice single crystals at temperatures between -20 C and -0.2 C were described. The power-law dependence of yield stress on strain-rate gives a value of n which varies from 1.95 + or - 0.04 at -0.2 C to 2.07 + or - 0.08 at -20 C. The activation energy of deformation varies with strain-rate, but a mean value of 70 + or - 2 kJ/mol was obtained, with no indication of any increase close to the melting point as has been found in polycrystalline ice. An apparent work-hardening effect, at strains greater than about 15%, was explained as being due to bending of the crystal changing the orientation of the basal planes. (See also W79-09342) (Humphreys-ISWS)
W79-09376

SHORT-TERM RHEOLOGY OF POLYCRYSTALLINE ICE,
National Research Council of Canada, Ottawa (Ontario). Div. of Building Research.
N. K. Sinha.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 457-473, 1978. 10 fig, 41 ref.

Descriptors: *Ice, *Rheology, *Model studies, *Theoretical analysis, Deformation, Mathematical models, Strain, Analytical techniques, Physical properties, Youngs modulus, Mechanical properties, Creep, Movement, Elastic deformation, Non-Newtonian flow, Rates, Crystallography, Polycrystalline ice.

Deformation characteristics of polycrystalline ice and their dependence on time, temperature, and stress were analyzed on the basis of a phenomenological relation which describes creep in terms of initial elastic, delayed elastic, and permanent strain. It was shown that the effective modulus of ice observed in the laboratory or in the field can be examined on the basis of this model. The model also provides a basis on which the observed flow law of ice can be examined conveniently. Some apparent inconsistencies in the results of earlier investigations of the mechanical property of ice appear to be reconciled by the model. (See also W79-09342) (Humphreys-ISWS)
W79-09377

THE EFFECT OF ANISOTROPY ON THE CREEP OF POLYCRYSTALLINE ICE,
Melbourne Univ., Parkville (Australia). Dept. of Meteorology.
R. C. Lile.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 475-483, 1978. 3 fig, 1 tab, 9 ref.

Descriptors: *Ice, *Anisotropy, *Model studies, *Deformation, Crystallography, Creep, Mathematical models, Isotropy, Crystals, Physical properties, Strain, Stress, Analytical techniques, Equations, Data collections, Polycrystalline ice.

Quantitative effects of crystallographic orientation fabrics were incorporated into the flow law for isotropic polycrystalline ice by the introduction of an enhancement factor applied to the isotropic fluidity. An aggregate was viewed to a first approximation as a collection of grains deforming independently by basal glide. The influence of preferred orientations on the mean intragranular rate of strain was treated in terms of a redistribution of the magnitude and orientation of resolved basal shear stress. A quantitative measure of this effect on the fluidity of the aggregate was provided through the development of a geometric tensor and a stress configuration parameter. Intergranular interference was then considered as a dissipative process modifying the fluidity of the aggregate. Empirical justification for the model at low octahedral shear stresses was provided by several laboratory creep tests on naturally anisotropic borehole specimens under both in situ and anomalous stress situations. Predicted enhancement factors ranged from approximately 0.2 to 2.8 and agreed well with measured values. The tests were carried out in uniaxial compression and simple shear. (See also W79-09342) (Humphreys-ISWS)
W79-09378

THE INFLUENCE OF ICE-CRYSTAL SIZE ON CREEP,
Wisconsin Univ.-River Falls. Dept. of Plant and Earth Sciences.
R. W. Baker.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 485-500, 1978. 4 fig, 2 tab, 50 ref. NSF GA-19310, GA-42728.

Descriptors: *Ice, *Creep, *Particle size, *Crystallography, Crystals, Deformation, Size, Laboratory tests, Analytical techniques, Analysis, Stress, Strain, Rates, Temperature, Compressive strength, Physical properties, Mechanical properties, Polycrystalline ice, Ice dislocations.

Uniaxial compression tests were conducted on polycrystalline-ice samples with random c-axis orientation, and steady-state creep rates were determined. Experiments were conducted on both inclusion-bearing and inclusion-free ice and were run at constant stress and constant temperature. During freezing, the presence of inclusions in low concentrations inhibits crystal growth; variations in the volume-fraction of inclusions thus result in variations in ice-crystal size. The creep rate of polycrystalline ice at high temperatures and moderate stresses is extremely sensitive to variations in ice-crystal size. Due to an apparent inversion between dislocation-controlled creep and diffusion-controlled creep, the optimum grain size for creep resistance is about 1 mm. Increasing or decreasing the average crystal size from this critical value results in an increase in secondary-creep rate. (See also W79-09342) (Humphreys-ISWS)
W79-09379

THE CREEP OF NACL-DOPED ICE MONOCRYSTALS,
Birmingham Univ. (England). Dept. of Mechanical Engineering.
N. W. Riley, G. Noll, and J. W. Glen.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 501-507, 1978. 2 fig, 1 tab, 18 ref.

Descriptors: *Ice, *Creep, *Crystallography, Mechanical properties, Sodium chloride, Laboratory tests, Crystals, Shear stress, Sea ice, Glaciers, Analysis, Analytical techniques, Monocrystals, Polycrystalline ice, Doped ice.

Monocrystals of ice grown from NaCl solutions (concentration 0.0005 to 0.01 mol/l) were tested in creep at -10 C by basal glide. The maximum resolved shear stress ranged from 0.6 to 2.5 bar. The resulting creep curves show a deceleration, that is, the creep rate decreases with time. At the highest concentration, the creep is essentially transient; the strain tends to a fixed value. This is unlike the behavior of similarly orientated monocrystals of pure ice or of ice grown from solutions of other dopants so far reported in the literature. The possible causes for this behavior were discussed, and the implementations for the mechanical properties of polycrystalline ice, in particular sea ice and glacier ice, were described. (See also W79-09342) (Humphreys-ISWS)
W79-09380

ON THE RELATIONSHIPS BETWEEN LOW-DENSITY AMORPHOUS SOLID WATER AND ICE IH,
Chicago Univ., IL. Dept. of Chemistry; and Chicago Univ., IL. James Frank Inst.
S. A. Rice, W. G. Madden, R. McGraw, M. G. Sceats, and M. S. Bergren.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 509-535, 1978. 21 fig, 2 tab, 37 ref.

Descriptors: *Ice, *Crystallography, *Molecular structure, *Water structure, Theoretical analysis, Laboratory tests, Physical properties, Chemical properties, Density, Mathematical models, Water, Spectrophotometry, Temperature, Hydrogen bonding, Bonding, Analytical techniques, Analysis, Ice Ih, Polycrystalline ice, Water molecules.

New experimental and theoretical studies of low-density amorphous solid water (H2O (as)) and of polycrystalline ice Ih were reported and integrated with other available data. A variety of evidence was put forward to support the conclusion that low-density H2O (as) is derived from ice Ih by slightly increasing the dispersion in the O-O separation and by introducing a distribution of O-O-O angles (width c. 8 deg). Theoretical analysis focussed attention on the consequences of strong intermolecular coupling of OH oscillators. The vibrational modes of both ice Ih and H2O (as) were found to be complex mixtures of molecular motions, so the identification of regions of the Raman or infrared spectra of these materials with particular isolated molecule modes is not useful. The theory developed gives a good, but not perfect, account of the OH stretching regions of the observed Raman and infrared spectra of ice Ih and, to a lesser degree, of low-density H2O (as). (See also W79-09342) (Humphreys-ISWS)
W79-09381

DYNAMICAL PROCESSES AT THE ICE-WATER INTERFACE DURING SOLIDIFICATION,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festokoerperphysik.
J. H. Bilgram, and H. Guttinger.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 537-545, 1978. 7 fig, 7 ref.

Descriptors: *Ice, *Freezing, *Crystal growth, *Boundary processes, Growth rates, Crystallography, Dynamics, Spectroscopy, Interfaces, Ice-water interfaces, Laboratory tests, Methodology, Refractivity, Analytical techniques, Mathematical models.

The dynamics of the freezing process was studied at the surface of a growing ice crystal by means of Rayleigh spectroscopy. Light is scattered quasi-elastically at the interface. The line width is proportional to the square of the scattering vector. For a scattering angle of 90 deg, one measures about 2 krad/s. The line width does not depend on the growth rate or thermal gradients at the interface. Light is scattered isotropically, which indicates that the correlation length is small compared with the wavelength of the scattered light. The intensity depends on the growth rate and shows a hysteresis in that dependence; at a minimum growth rate, the onset of fluctuations is observed. (See also W79-09342) (Humphreys-ISWS)
W79-09382

CHARGE SEPARATION BY COLLISION OF ICE PARTICLES ON METALS: ELECTRONIC SURFACE STATES,
Eidgenoessische Inst. fuer Schneeund Lawinenforschung, Davos (Switzerland).
O. Buser, and C. Jaccard.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 547-557, 1978. 6 fig, 3 tab, 17 ref.

Descriptors: *Ice, *Electrical properties, *Electrical studies, Laboratory tests, Electric fields, Surfaces, Metals, Mathematical models, Analysis, Analytical techniques, Collision parameters, Permittivity, Surface charge.

The charge separation of ice particles colliding with metals was investigated in a wind tunnel (air speed 10 m/s) at a temperature of -45 C for different metals as a function of an applied external electric field. The ice particles (10 micrometer radius) collided with the metal target at a rate of 100,000 per second. The charge separation produced by different metals can be explained by the contact potential difference between the metal and the ice introducing electronic surface states on the ice. A lower limit for their density (10 to the 16th power/sq m) was found. The influence of the electric field was explained by an interaction between Bjerrum defects and the electrons of the metal, the transfer probability depending on the charge in the surface states. (See also W79-09342) (Humphreys-ISWS)
W79-09383

OPTICAL ABSORPTION SPECTRA OF H2O ICE DOPED WITH YTTERBIUM CHLORIDE YBCL3,
Centre National de la Recherche Scientifique, Orsay (France). Lab. Aime Cotton.
L. Couture.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 559-563, 1978. 2 fig, 1 tab, 8 ref.

Descriptors: *Ice, *Optical properties, *Absorption, *Crystallography, Chlorides, Spectroscopy, Analytical techniques, Ions, Laboratory tests, Analysis, Crystals, Doped ice, Rare-earth ions, Ytterbium chloride.

Near-infrared absorption spectra of a frozen dilute solution of ytterbium chloride were obtained at 77 K, 20 K, and 4.2 K. They contain two broad lines revealing a Stark splitting of 60/cm of the excited 2F sub 5/2 level of the Yb(3+) ion. Such spectra indicate that in frozen solutions of ytterbium chloride the Yb(3+) ions have crystalline or quasi-crystalline surroundings which are similar for most ions; possibilities were discussed. (See also W79-09342) (Humphreys-ISWS)
W79-09384

MOLECULAR ORBITAL CALCULATIONS OF WATER-ICE SURFACE INTERACTIONS,
Missouri Univ.-Rolla. Dept. of Physics.
P. L. M. Plummer.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 565-580, 1978. 13 fig, 2 tab, 27 ref.

Descriptors: *Ice, *Model studies, *Ice-water interfaces, *Boundary processes, Molecular structure, Crystals, Surfaces, Nucleation, Water, Hydrogen bonding, Analysis, Frequency, Energy, Interfaces, Ice Ih, Electron density.

Detailed knowledge of the energetics of the interaction of a water monomer with an ice surface is important in understanding the factors which control both the nucleation of an ice surface and semi-empirical quantum-mechanical calculations of the CNDO/INDO type to investigate the energentics of a gas-phase molecule approaching the surface. In the attempt to simplify the system as much as possible while retaining the essential features of the 'real' physical situation, 13 water molecules arranged in the lattice positions for ice Ih were used to represent the surface. Electron-density plots for both basal and prism surfaces were generated. Potential-energy curves were calculated for a monomer approaching a number of different sites on each type of surface. Monomer-surface binding energies varied from approximately 17 to 33 kJ/mol for the surface sites examined. Ion pairs of the H2O(+) - OH(-)-type were included in the surface, and their effect on the energy of interaction with an incoming monomer was calculated. For these studies, no distortion of the ice surface was allowed. The energies found follow the same trends as those observed for a free monomer-ion interaction. (See also W79-09342) (Humphreys-ISWS)
W79-09385

FRAZIL NUCLEATION MECHANISMS,
Wheeling Coll., WV. Dept. of Physics.
T. O'D. Hanley.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 581-587, 1978. 3 fig, 22 ref.

Descriptors: *Frazil ice, *Nucleation, *Ice, *Freezing, Crystallography, Theoretical analysis, Supercooling, Cooling, Analysis, Temperature.

It has been suggested previously that frazil nucleation occurs by a mechanism analogous to spinodal decomposition, aided by turbulence. After further study, the following points were made: (1) No critical point exists between solid and liquid; this rules out true spinodal decomposition. (2) Pure water can be supercooled to -40 C; at -40 C, the theoretical energy barrier to nucleation is about 10 to the minus 19th power J. Frazil forms after supercooling less than 0.1 deg; at this temperature, the theoretical energy barrier is about 10 to the minus 14th power J. (3) Theory shows that turbulence increases the energy barrier. (4) Turbulence may aid dissipation of heat solidification, but not sufficiently to account for observed frazil formation at small supercoolings. (5) The evidence that frazil can begin to form at supercoolings as small as 0.02 deg suggests that no nucleus except ice itself can account for 'heterogeneous' nucleation of frazil. (See also W79-09342) (Humphreys-ISWS)
W79-09386

STRUCTURE AND BEHAVIOUR OF GRAIN BOUNDARIES IN POLYCRYSTALLINE ICE,
Hokkaido Univ., Sapporo (Japan). Dept. of Applied Physics.
A. Higashi.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 589-605, 1978. 11 fig, 3 tab, 24 ref.

Descriptors: *Ice, *Reviews, *Crystallography, *Structure, Mechanical properties, Crystals, Mathematical modeling, Surfaces, Topography, Laboratory tests, Data collections, Analytical techniques, Bonding, Boundaries(Surfaces), X-ray diffraction, Movement, Oxygen, Polycrystalline ice, Ice dislocations.

Recent progress in studies of the structure and behavior of grain boundaries in ice was reviewed. As a lattice geometrical model of the boundary, the coincidence-site lattice (CSL) model was considered for ice crystals. Some evidence of the validity of this model was presented through observations of special shapes of natural snow, results of grain-boundary energy measurements, and direct microscopic observations of boundaries by X-ray diffraction topography. Although methods of measurement of grain-boundary energy have been developed recently, results are still not adequate to be analyzed in terms of real energetics for comparison with models of atomic bonding. Modern methods of observing grain boundaries in ice using X-ray diffraction topography were described. Observations of migrating boundaries have revealed that faceting along most closely packed CSL points impedes the migration of the CSL boundaries, while increased numbers of steps among facets with boundaries of other kinds enhance it. The mobility of a fast-moving boundary was determined to be of the order of 10 to the minus 10th power cu cm/dyn/s, either in the case when the driving force is the capillary force due to the boundary energy or when it is the stored energy of dislocations. (See also W79-09342) (Humphreys-ISWS)
W79-09387

CRYSTALLOGRAPHIC STRUCTURE OF POLYCRYSTALLINE ICE,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
M. Matsuda, and G. Wakahama.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 607-620, 1978. 8 fig, 41 ref.

Descriptors: *Ice, *Structure, *Crystallography, *Bonding, Crystals, Oxygen, Hydrogen bonding, Molecular structure, Movement, Data collections, Glaciers, Analysis, Polycrystalline ice.

For several types of polycrystalline ice of different origins, the spatial lattice orientation of each crystal was determined by measurements of both the a- and c-axis orientations. Analyses of the orientations of adjoining crystals showed that a great majority of adjoining crystals may be in a twinning relation. With special reference to the multi-maximum c-axis preferred-orientation fabric (the so-called 'diamond pattern'), which is expected to occupy the largest part of a glacier ice mass, the crystal boundary structure was estimated. The preferred c-axis orientations of this fabric were explained as being the result of coincident oxygen-oxygen lines (hydrogen-bond lines) between adjoining crystals being concentrated in the orientations where 7 oxygen-oxygen lines of one single crystal of ice are distributed. From the above result, it was concluded that the multi-maximum fabric is of the polycrystalline structure closest to the structure of a single crystal of ice among all the fabrics found in large ice masses. It was found that the occurrence, in glaciers and ice sheets, of a multi-maximum fabric has a bias to the parts which have undergone a strong shear deformation for a long time. It is thus suggested that plastic deformation of ice with this fabric may be attributed to mechanical twinning due to a strong shear stress. (See also W79-09342) (Humphreys-ISWS)
W79-09388

ANELASTIC BEHAVIOUR OF POLYCRYSTALLINE ICE,
Centre National de la Recherche Scientifique, Grenoble (France). Lab. de Glaciologie.
P. Duval.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 621-628, 1978. 3 fig, 1 tab, 20 ref.

Descriptors: *Ice, *Creep, *Deformation, *Crystallography, Laboratory tests, Mechanical properties, Elastic deformation, Strain, Data collections, Analytical techniques, Stress, Glaciers, Time, Acti-

vation energy, Measurement, Velocity, Polycrystalline ice, Anelastic strain, Ice dislocations.

Torsion creep tests were performed on glacier ice at temperatures above -12 C. The polycrystalline ice, when unloaded, exhibits creep recovery. The time-dependent recoverable component of deformation (or anelastic strain) epsilon sub a was found to be adequately described by a relationship of the form: epsilon sub a equals delta tau log (1 + alpha t)/h where delta tau is the stress decrement, alpha a constant, and t the time. The anelastic modulus h defined for times t in excess of 3 h is always smaller than the dynamic elastic modulus. The movement of dislocations composing the sub-boundaries or in dislocation pile-ups may produce this important reversible deformation. The time-dependent recovery was explained in a similar way to the transient creep behavior observed at low temperatures for metals. The small temperature dependence of creep recovery would arise from the existence of a distribution of internal stresses values. (See also W79-09342) (Humphreys-ISWS)
W79-09389

X-RAY DIFFRACTION TOPOGRAPHIC OBSERVATIONS OF THE LARGE-ANGLE GRAIN BOUNDARY IN ICE UNDER DEFORMATION,
Hokkaido Univ., Sapporo (Japan). Dept. of Applied Physics.
T. Hondoh, and A. Higashi.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 629-638, 1978. 5 fig, 8 ref.

Descriptors: *Ice, *Deformation, *Crystallography, *Structure, Laboratory tests, X-ray diffraction, Analytical techniques, Crystals, Topography, Data collections, Testing procedures, Boundaries(Surfaces), Analysis, Photography, Surfaces, Polycrystalline ice.

Large-angle tilt grain boundaries in artificially-grown ice bicrystals were observed by the method of X-ray diffraction topography. In bicrystals for which misorientation angles satisfy the conditions of a high-density coincidence site lattice (CSL) at the boundary, the images of fine parallel line defects appear on the topograph taken immediately after a light deformation. Since these images disappear in a time period between several hours and a few days and reappear again at the same sites when the specimen is deformed subsequently, it was concluded that these line defects are not stable like the boundary dislocations but may be steps generated on the boundary to form facets which coincide with the high-density CSL plane. X-ray topographic images of boundaries which do not satisfy the conditions of a high density CSL are complex and difficult to interpret, although some of the images indicate that there may be different types of structures on such boundaries. (See also W79-09342) (Humphreys-ISWS)
W79-09390

REGELATION AND THE DEFORMATION OF WET SNOW,
Army Terrestrial Sciences Center, Hanover, NH.
S. C. Colbeck, and N. Parssinen.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 639-650, 1978. 8 fig, 1 tab, 17 ref.

Descriptors: *Snow, *Ice, *Deformation, *Crystallization, Crystallography, Model studies, Mathematical models, Boundary processes, Theoretical analysis, Density, Melting, Freezing, Crystal growth, Temperature, Heat flow, Growth rates, Boundaries(Surfaces), Films, Regelation, Wet snow, Phase equilibrium.

The thermodynamics of phase equilibrium control the temperature distribution around the ice particles in wet snow. When the snow is stressed, pressure melting occurs at the inter-particle contacts and the snow densifies. Densification was described by a physical model which simulates the heat flow, melt-water flow, and particle geometry. The effects of ionic impurities, liquid saturation, and particle size were demonstrated. Typical values of the temperature difference, inter-particle film size, and density were calculated as functions of time. The calculated rates of compaction are too large, hence, at some later time, the effects of simultaneous grain growth must be added to the model. (See also W79-09342) (Humphreys-ISWS)
W79-09391

FRACTURE TOUGHNESS OF ICE: A PRELIMINARY ACCOUNT OF SOME NEW EXPERIMENTS,
Cambridge Univ. (England). Cavendish Lab.
D. J. Goodman, and D. Tabor.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 651-660, 1978. 6 fig, 2 tab, 17 ref.

Descriptors: *Ice, *Laboratory tests, *Mechanical properties, *Failure(Mechanics), Analytical techniques, Testing procedures, Cracks, Sampling, Methodology, Analysis, Stress, Temperature, Strength of materials.

This paper described the first results from an experiment to measure the fracture toughness of ice. Two experimental techniques were used, first, fracture of pre-notched rectangular specimens in three- and four-point bending, and second, from the observation of the cracks which form underneath an indenter forced into the ice surface. In the second test the indenter behaves like a wedge. It was observed that for indenters with large interior angles, the plastic zone beneath the indenter may itself behave like a wedge. Data obtained over a range of temperatures were compared with the little other data available. A decrease of fracture toughness was found as the temperature was lowered. (See also W79-09342) (Humphreys-ISWS)
W79-09392

ANISOTROPY OF THE KINETIC FRICTION ON A SINGLE CRYSTAL OF ICE,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
K. Tusima.
In: Symposium on the Physics and Chemistry of Ice; Proceedings of the Third International Symposium, Cambridge (England), September 12-16, 1977. Journal of Glaciology, Vol. 21, No. 85, p 661-668, 1978. 7 fig, 1 tab, 7 ref.

Descriptors: *Ice, *Anisotropy, *Physical properties, *Crystallography, Kinetics, Friction, Crystals, Measurement, Movement, Laboratory tests, Temperature, Analytical techniques, Analysis, Kinetic friction, Monocrystals.

Measurements were made of the kinetic friction which occurs when a tungsten carbide ball slides in various directions on the surface of a single crystal of ice, and the track width produced on the surface was also measured. Anisotropies were detected in both the friction coefficient and the track width. The track width phi was at a maximum when the ball was slid normal to the basal plane and at a minimum when it was moving parallel to (0001) in the temperature range -5 to -30 C. Although the friction coefficient was at a minimum when slid normal to (0001) and maximum in parallel to (0001) at temperatures of -19 C and below, this relation was found to be reversed at temperatures of -10 C and above. Anisotropy in track width can be explained in terms of the amount by which a slip system contributes to deformation in a specimen. However, our understanding of frictional anisotropy calls for knowledge of the ploughing strength p defined by the adhesion theory of friction. It was found that p reached a maximum in parallel to (0001) and a minimum normal to (0001). A remarkable frictional anisotropy was also observed on the surface inclined to the basal plane at 30 deg; the maximum friction coefficient was twice the minimum, whereas the maximum track width was only 1.3 times the minimum. (See also W79-09342) (Humphreys-ISWS)
W79-09393

2D. Evaporation and Transpiration

CALCULATED AND OBSERVED NONISOTHERMAL MULTIPHASE FLOW IN VERTICAL COLUMNS,
Atlantic Richfield Hanford Co., Richland, WA. Scientific Systems Dept.
R. W. Nelson, and P. G. Easley.
Available from the National Technical Information Service, Springfield, VA 22161 as ARH-SA-278, Price codes: A02 in paper copy, A01 in microfiche. Preliminary Report No. ARH-SA-278. (1976) Prepared for the U.S. Energy Research and Development Administration. 16 p. E (45-1) 2130.

Descriptors: *Mathematical models, *Water loss, *Soil moisture, *Deserts, Air, Sierozems, Nonisothermal multiphase flow, Vertical flow, Diffusion, Evaporation, Osmosis, Lysimeters, Moisture content.

The movement of air, water vapor, and liquid water in dry desert soils was modeled in a mathematical formulation. The model was applied to field measurements from two lysimeters at a site at the 200 Areas plateau of the Hanford Reservation in Washington. The water table is 60 to 90 meters below the ground surface with an average rainfall of 6.3 inches. The model allows for minor flow mechanisms important under long term arid conditions such as temperature induced flow, vapor diffusion, and osmotic effects. The model combines equations from the oil industry for non-isothermal multiple phase flow and those from soil science which include the effects of vapor diffusion in a static air phase. Finite differences or collocation on finite elements for long- one-dimensional vertical flow systems under very low moisture conditions can be used to solve the equation. Results show significant flow direction reversals caused by temperature induced vapor transport. Computations were qualitatively consistent with field observations at the lysimeter sites. (Seigler-IPA)
W79-09428

DEVELOPMENT AND EVALUATION OF EVAPOTRANSPIRATION MODELS FOR IRRIGATION SCHEDULING,
Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
J. L. Wright, and M. E. Jensen.
Transactions of the American Society of Agricultural Engineers, Special Edition, Vol. 21SW, No. 1, p 88-91, 96, February 20, 1978. 6 fig, 1 tab, 7 ref.

Descriptors: *Evapotranspiration, *Model studies, Irrigation scheduling, Lysimeters, Soil water.

Evapotranspiration (ET) data for irrigated crops in southern Idaho were used to develop relationships for estimating net radiation and potential ET for the USDA-ARS Computerized Irrigation Scheduling Program. ET estimated with the initial relationships compared well with recent measurements obtained with two sensitive weighing lysimeters. The average daily measured ET for alfalfa for 128 days when there was full cover was 7.23 mm, while the average daily estimated ET was 7.15 mm. Crop curve relationships were developed from the ET results for snap beans (Phaseolus vulgaris L.). The depletion of soil water was predicted for two years of irrigated beans with the scheduling program using the improved crop curves and compared with the measured as a test of its performance. The standard deviation of the difference between predicted and measured was about 0.95 mm/day from planting until harvest. The results also demonstrated the importance of obtaining representative meteorological data for irrigation scheduling. (Skogerboe-Colorado State)
W79-09496

2E. Streamflow and Runoff

FLOOD PLAIN INFORMATION: RED LAKE RIVER, CROOKSTON, MINNESOTA,
Army Engineer District, St. Paul, MN.
Prepared for The City of Crookston, Minnesota, December 1974, 37 p, 26 fig, 18 plates, 4 tab.

Descriptors: *Minnesota, *Floods, *Indirect flood measurement, *Flood profiles, *Flood data, *Flood stages, *Peak discharge, *Flood plains, *Flood protection, *Crookston(MN), *Red Lake River(MN), Runoff, Flood flow, Flood forecasting, Historic floods, Flood frequency, Stage-discharge relations, Rivers, Floodways, Ice jams, Standard Project Flood, Warning systems, Control structures, Levee, Intermediate Regional Flood.

This report gives flood information for the Red Lake River in the vicinity of Crookston, Minnesota. The study reach is a tributary of the Red River and encompasses a drainage area of about 5,280 square miles above Crookston. This section of the river is about 18.3 miles long. Flood plain width varies from about 700-2,000 feet. The flood plain contains residential, commercial, and agricultural developments, and several parks and recreational facilities. A U.S. Geological Survey gage is located in Crookston. Causes of flooding include runoff from spring snowmelt, and occasional heavy summer rains. Obstructions to flood flow include trees, brush, and other floodway vegetation and floating ice blocks during spring thaw. Major floods occurred most recently in 1950, 1965, 1966, 1969, and 1974. The April 1969 flood had a peak discharge of 28,400 cubic feet per second (cfs), cresting at 27.3 feet above flood stage, while the April 1974 flood discharged 17,700 cfs and crested at 22.9 feet above flood stage. By comparison, the Intermediate Regional Flood (IRF) and the Standard Project Flood (SPF) are estimated to discharge 31,000 cfs and 51,400 cfs and crest at 26.9 feet and 30.1 feet, respectively. Flood damage reduction measures include construction of earth levees, flood warning and forecasting from the National Weather Service, and institution of a flood evacuation plan. (Arnold-NC)
W79-09338

SPECIAL FLOOD HAZARD INFORMATION: SOUTH BRANCH ROOT RIVER AT PRESTON, MINNESOTA,
Army Engineer District, St. Paul, MN.
Prepared for the City of Preston, Minnesota, June 1975, 45 p, 22 fig, 25 plates, 5 tab.

Descriptors: *Minnesota, *Floods, *Indirect flood measurement, *Flood profiles, *Flood data, *Flood stages, *Peak discharge, *Flood plain management, *Flood protection, *Preston(MN), *South Branch Root River(MN), Runoff, Flood flow, Flood forecasting, Flood frequency, Stage-discharge relations, Rivers, River beds, Floodways, Flood plains, Standard Project Flood, Flood plain zoning, Flood plain insurance, Planning, Control structures, Intermediate Regional Flood.

This report details flood hazard information for that portion of the South Branch of the Root River near Preston, Minnesota. A tributary of the Mississippi, the South Branch Root River encompasses a 180 square mile drainage area upstream of Preston. The study reach is 5 miles long with an average stream slope of 7.9 feet per mile. Development in the flood plain is primarily residential and recreational, with some industrial and commercial development. Data were obtained from one stream gage, newspaper files, historical documents and other records. The main flood season is during spring with some flooding occurring in summer. A flood improvement project in 1966 included construction of a bridge and channel widening. There are no existing structures for flood damage reduction in the study area. Obstructions to flood flow include trees, vegetation, dams, bridges, culverts and ice jams. The largest recorded flood occurred in March 1950, discharging 18,900 cubic feet per second (cfs) and cresting at 14.8 feet above flood stage. Another flood in 1965 discharged 7,000 cfs, cresting at 10.7 feet above flood stage. In comparison, the projected Intermediate Regional Flood (IRF) and the Standard Project Flood (SPF) would discharge up to 19,500 cfs and 51,300 cfs, respectively, below Camp Creek. Flood plain management program measures for the area are recommended to include flood control measures; strict adherence to the 1969 Minnesota Flood Plain Management Act; enactment of zoning ordinances, subdivision regulations, and building codes; memeberships in the National Flood Insurance Program; and floodproofing existing structures. (Arnold-NC)
W79-09339

FLOOD PLAIN INFORMATION: SNAKE RIVER, CITY OF WARREN, MINNESOTA,
Army Engineer District, St. Paul, MN.
Prepared for the City of Warren, Minnesota, September 1973, 34 p, 17 fig, 10 plates, 3 tab.

Descriptors: *Minnesota, *Floods, *Runoff, *Flood profiles, *Flood stages, *Peak discharge, *Flood peak, *Flood plains, *Channels, *Warren(MN), *Snake River(MN), Flood flow, Indirect flood measurement, Flood forecasting, Historic floods, Flood data, Stage-discharge relations, Rivers, River beds, Standard Project Flood, Warning systems, Channel improvement, Intermediate Regional Flood.

This report gives flood information for the Snake River near Warren, Minnesota. The study reach a tributary of the Red River, is about 7 miles long with an average gradient of 3 feet per mile drop and encompasses a drainage area of 260 square miles. Flood plain width varies from about 500 to 2,500 feet. Seventy five percent of the City of Warren has been flooded by recent floods, and the entire town would be flooded by the Intermediate Regional Flood (IRF). Major causes of flooding are runoff from snowmelt and flow restrictions due to sewer backup. Obstructions to floodflow include trees, brush and vegetation in the floodway. Data were obtained from stream gages, newspaper files and historical records. Major floods occurred in 1896, 1901, 1950 and 1969. The April 1969 flood is the largest flood of record and had a peak discharge of 4,300 cubic feet per second (cfs), cresting at 19.4 feet above flood stage. The IRF and Standard Project Flood (SPF) would discharge 5,500 cfs and 10,500 cfs, respectively, cresting at 19.6 feet and 20.1 feet above flood stage. Flood damage reduction measures include clearing floodway of debris and tying in with the National Weather Service flood forecasting service. No city or county flood control or building code ordinances exist. This report is intended as a guide for land use planning and management decisions concerning flood plain utilization. (Arnold-NC)
W79-09340

FLOOD HAZARD INFORMATION: DOLORES RIVER AND TRIBUTARIES, DOLORES, MONTEZUMA COUNTY, COLORADO,
Army Engineer District, Sacramento, CA.
Prepared for Town of Dolores; Montezuma County; and the Montelores Planning Group, September 1978, 11 p, 31 plates, 2 tab.

Descriptors: *Colorado, *Floods, *Flood profiles, *Rivers, *Dolores River(CO), *Dolores(CO), *Montezuma County(CO), 100-year flood, 500-year flood, Regional flood, Indirect flood measurement, Storms, Cloudbursts, Historic floods, Flood data, Flood stages, Peak discharges, Flood plains, Flood protection, Flood plain insurance, Control structures, Reservoirs, West Dolores River(CO), Lost Canyon Creek(CO).

This report covers the findings of a flood hazard study of a 15-mile study reach of the Dolores River near Dolores, Colorado. A tributary of the Colorado River, the Dolores flows northwesterly into southeastern Utah to join that stream 100 miles northwest of the Town of Dolores. From its widest point, the Dolores River watershed encompasses a drainage area of about 570 square miles. The drainage basin is largely undeveloped, consisting of heavily forested areas within the flood plain. No significant future development is forecast. Other development in the floodway includes four highway bridges and a dam creating the McPhee Reservoir at the downstream limit of the study reach. A U.S. Geological Survey gage exists near the 4th Street Bridge at the Town of Dolores. Flooding from spring snowmelt runoff can occur, but flooding is primarily caused by summer cloudbursts. The largest flood of record occurred in October 1911, and other notable floods occurred in October 1941 and September 1970. The 100-year and 500-year floods would discharge 14,500 cubic feet per second (cfs) and 36,000 cfs, respectively, on the Dolores River below the mouth of Lost Canyon Creek. Velocity flow during a 100-year flood would reach 7-8 feet per second (fps), nearly the limit of 10 fps above which serious streambank erosion would occur. This report is intended to provide a basis for planning the best use of lands subject to inundation by the 100-year flood. (Arnold-NC)
W79-09341

FLOODS IN THE SKUNK RIVER BASIN, IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
A. J. Heinitz, and S. W. Wiitala.
Geological Survey open-file report 79-272, December 1978. 80 p, 28 fig, 2 tab, 9 ref.

Descriptors: *Flood profiles, *Floods, *Flood peak, *Flood discharge, *Historic floods, Flood frequency, Streamflow, Flow characteristics, Flood data, *Skunk River basin(Iowa).

Evaluation of flood hazards, and the planning, design, and operation of various facilities on flood plains require information on floods. This report provides information on flood stages and discharges, flood magnitude and frequency, and flood profiles for the Skunk River, Iowa, and some of its tributaries. It covers the Skunk - South Skunk Rivers to Ames, and the lower reaches of tributaries as follows: Squaw Creek, 8.2 miles; Indian Creek, 11.6 miles; North Skunk River, 83.2 miles; Cedar Creek, 55.8 miles; and Big Creek, 21.7 miles. The random nature of flood occurrence is illustrated by a graph of annual flood peaks at the gaging station on the Skunk River at Augusta. Maximum recorded flood discharges at gaging stations in the Skunk River basin are tabulated. A complete list of flood peaks for each station is included. (Woodard-USGS)
W79-09398

TECHNIQUE FOR ESTIMATING DEPTH OF 100-YEAR FLOOD IN NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
A. J. Velnich, and S. L. Laskowski.
Geological Survey open-file report 79-419, March 1979. 19 p, 6 fig, 2 tab, 5 ref.

Descriptors: *Floods, *Flood plains, *Depth, *New Jersey, Streams, Flood profiles, Flood frequency, Flood forecasting, Methodology, Equations, Topography, Mapping, *Flood-prone areas, *Flood plain management, 100-year flood.

Techniques are developed for use in estimating 100-year flood depths on New Jersey streams. Equations and graphs are presented relating the 100-year flood depth above the mean annual flood to drainage area and area of lakes and swamps. Separate relations for the Coastal Plain and non-Coastal Plain streams in the four hydrologic areas in New Jersey are shown. A method of mapping flood-prone areas on U.S. Geological Survey 7.5-minute topographic quadrangles is detailed. (Woodard-USGS)
W79-09407

HEADWATER LOCATIONS OF U.S. STREAMS TRIBUTARY TO ST. LAWRENCE RIVER BASIN BETWEEN WESTERN OHIO AND EASTERN NEW YORK, EXCLUDING LAKE CHAMPLAIN BASIN,
Geological Survey, Albany, NY. Water Resources Div.
B. B. Eissler.
Geological Survey open-file report 79-255, 1979. 740 p, 1 fig, 3 plates, 3 tab, 4 ref.

Descriptors: *Headwaters, *Sites, *Streams, *Tributaries, *Great Lakes region, Lake Ontario, Lake Erie, St Lawrence River, Drainage area, Watersheds(Basins), Streamflow, New York, Ohio, Pennsylvania, Topographic mapping, *Quadrangles, *Niagara River.

The headwater locations of several thousand U.S. streams tributary to Lakes Ontario and Erie and the St. Lawrence and Niagara Rivers, from the

Maumee River in Ohio to the western border of the Lake Champlain basin in New York, including parts of Pennsylvania, are listed by quadrangle. The location of the headwater of each is given with reference to cultural and topographic features. 'Headwater' in this report is defined as the first site downstream from which the average streamflow is 5 cubic feet per second. The site locations were determined from drainage areas as indicated on topographic maps. The size of the drainage area required to produce an average flow of 5 cubic feet per second was determined from equations, developed separately for each State by regression techniques, that define the relation between streamflow and hydrologic factors of the region. Drainage area and precipitation were factors in the equations for all three States: forest cover was found to be significant in Ohio. (Woodard-USGS)
W79-09408

FLOWLINE STUDY, MISSISSIPPI AND ILLINOIS RIVERS: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
J. E. Foster.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 695, Price codes: A04 in paper copy, A01 in microfiche. Mississippi Basin Model Report No. 31-5, June 1977. 62 p, 25 fig, 7 tab.

Descriptors: *Mississippi River, *Illinois River, *Flow characteristics, *Fixed-bed models, *Flood profiles, *Mathematical models, Flow profiles, Flow rates, Hydrographs, Levees, Inflow, Discharge(Water), Model studies.

The Mississippi Basin Model (MBM), a fixed-bed model of the Mississippi River and its tributary system from Hannibal, Missouri, to Baton Rouge, Louisiana, was used to develop water surface frequency profiles for portions of the Mississippi and Illinois Rivers. To insure the accuracy of the model, it was adjusted to reproduce the conditions of a 1973 flood. Model tests were conducted with three series of flows of 5 to 500 year frequencies and the agricultural and urban design floods on the rivers. Flowlines were tested with three levee conditions ranging from existing levees to proposed authorized levees. Water surface evaluations for all tests were recorded in the channel at all model gaging stations and at other points necessary to give a detailed profile at approximately one mile intervals along the various levee units. Major results show that existing federally constructed Mississippi River levees will protect against floods of at least a 50-year frequency. Also, increasing the height of existing levees to authorized grades would provide increased protection for these levee units but would raise stages slightly on unprotected areas. Levee maps and stage hydrographs are provided. (Seigler-IPA)
W79-09435

FLASH FLOOD DEFENSES,
National Oceanic and Atmospheric Administration, Boulder, CO. Atmospheric Physics and Chemistry Lab.
R. A. Maddox, and C. F. Chappell.
Water Spectrum, Vol. 11, No. 2, p 1-8, Spring 1979. 12 fig, 1 ref.

Descriptors: *Flash floods, *Flood forecasting, *Flood protection, Runoff, Meteorology, Thunderstorms, Hurricanes, Cloudbursts, Rainfall intensity, Rain gages, Clouds, Hydrography, National Weather Service, Flash Flood Alarm Systems, Johnstown(Pennsylvania), Satellite observation, Detection.

The severity of flash flooding in the United States and actions that can be taken to reduce the severity are discussed. During the 1970s, flash flooding became one of the most significant natural disaster problems in the United States. Flash flood fatalities exceed 160 annually, with property damage from all types of flooding exceeding one billion dollars annually. Reasons for these increases include: the rapid spread of urban development which often disrupts natural stream drainage patterns; vacationers often visit flash flood prone areas during periods of maximum threat; and people who live along 'controlled' streams and drainages often have the attitude that 'it can't happen here'. Two steps in an effective flash flood warning system, predictions and detection, are discussed. Ideally, the prediction phase should precede the actual flood by three to six hours so that state and local agencies can gear up to cope with the flood. The National Weather Service States Forecast Officers have the responsibility for monitoring meteorological conditions to determine if threatening conditions are developing. After a dangerous storm develops, the problem becomes one of determining if and where the heavy rains are falling. The simplest means of detection is through a cooperation spotter network. Several other detection devices are also discussed. (Seigler-IPA)
W79-09464

FLOOD HAZARD ANALYSES: BEAVER CREEK -- NAKED CREEK, ASHE COUNTY, NORTH CAROLINA,
Soil Conservation Service, Raleigh, NC.
In cooperation with the North Carolina Department of Natural Resources and Community Development, New River Soil and Water Conservation District, Board of County Commissioners, May 1979. 89 p, 40 fig, 14 tab, 9 ref, 8 append.

Descriptors: *North Carolina, *Beaver Creek, *Naked Creek, *Flood plains, *Flood plain insurance, Land use, Elevation, Mountains, Water levels, Urbanization, Aerial photography, Discharge(Water), Channels, Watersheds(Basins), Surface waters, Hydrographs.

A flood plain study was made for Ashe County, North Carolina to aid in developing regulations for flood plain land use and to qualify for flood insurance under the Department of Housing and Urban Development National Flood Insurance Program. Data are presented for Beaver Creek and Naked Creek, tributaries of South Fork of New River. The area is characterized by numerous high mountains and steep slopes, lower mountains with gentle slopes, and smooth rolling and gently rolling country between the mountains. Some development has already encroached onto the Beaver Creek flood plain. Additional pressure for flood plain development with future population growth and industrial expansion is anticipated. In the 10.4 mile length of Beaver Creek, Cole Brance, and tributaries 1 and 2, 247 acres are flooded with the 100-year flood and 284 acres with the 500-year flood. Some residential development has occurred on the Naked Creek flood plain. In the 6.4 mile length of Naked Creek, 204 acres are inundated with the 100-year flood and 241 acres with the 500-year flood. The potential for flooding along both creeks is high, with the annual flood event causing some flooding in the lower part of the flood plain. Data presented for identifying areas subject to flooding and the depth of flooding include: (1) flood hazard area photomaps; (2) flood profiles for the photomaps; (3) cross sections showing general valley and channel shapes; (4) discharge and elevation for selected floods; and (5) the description, elevation, and location for elevation reference marks. (Seigler-IPA)
W79-09477

FLOOD HAZARD ANALYSES: NORTH FORK -- NEW RIVER, ASHE COUNTY, NORTH CAROLINA,
Soil Conservation Service, Raleigh, NC.
In cooperation with the North Carolina Department of Natural Resources and Community Development, New River Soil and Water Conservation District, Board of County Commissioners, May 1979. 110 p, 93 fig, 4 tab, 10 ref, 8 append.

Descriptors: *North Carolina, *New River, *Flood plains, *Flood plain insurance, Land use, Elevation, Mountains, Water levels, Urbanization, Aerial photography, Discharge(Water), Channels, Watersheds(Basins), Surface waters, Hydrographs, Drainage area.

A flood plain study was made for Ashe County, North Carolina, to aid in developing regulations for flood plain land use and to qualify for flood insurance under the Department of Housing and Urban Development National Flood Insurance Program. The North Fork of New River has a drainage area of 289 square miles at its confluence with South Fork. In the 50.6 mile length of the North Fork, 1948 acres are inundated by the 100-year flood and 2,385 acres by the 500-year flood. The flood hazard analyses performed were developed for present conditions. Development in the area is primarily rural homes. Records show the August 14, 1940 flood to be the largest since 1908 when stream gage records were started. The potential for flooding along the North Fork is high, with the annual flood event causing some flooding in the lower areas of the flood plain. A well managed flood plain management program can limit the damage caused by these floods. Data presented for identifying areas subject to flooding and the depth of the flooding include: (1) flood hazard area photomaps; (2) flood profiles for the photomaps; (3) cross sections showing general valley and channel shapes; (4) discharge and elevation for selected floods; and (5) the description, elevation, and location for elevation reference marks. (Seigler-IPA)
W79-09478

FLOOD HAZARD ANALYSES: SOUTH FORK -- NEW RIVER, ASHE COUNTY, NORTH CAROLINA,
Soil Conservation Service, Raleigh, NC.
In cooperation with the North Carolina Department of Natural Resources and Community Development, New River Soil and Water Conservation District, Board of County Commissioners, June 1979. 158 p, 111 fig, 4 tab, 10 ref, 8 append.

Descriptors: *North Carolina, *New River, *Flood plains, *Flood plain insurance, Land use, Elevation, Mountains, Water levels, Urbanization, Aerial photography, Discharge(Water), Channels, Watersheds(Basins), Surface waters, Hydrographs, Drainage area.

A flood plain study was made for Ashe County, North Carolina, to aid in developing regulations for flood plain land use and to qualify for flood insurance under the Department of Housing and Urban Development National Flood Insurance Program. The area is in the Blue Ridge land resource area and is characterized by numerous high mountains, lower mountains, and smooth rolling country. The South Fork of New River has a drainage area of 324 square miles at its confluence with North Fork. In the 63.8 mile length of the South Fork, 3,423 acres flood with the 100-year flood and 3,969 acres with the 500-year flood. Development in the flood plain is primarily rural homes. The most recent flood occurred in 1978 and approached the 75-year flood. Flooding, caused by locally intense thunderstorms, and hurricanes, is often distributed throughout the year. The potential for flooding along the South Fork will remain high, with the annual flood event causing flooding in the lower areas of the flood plain. Data presented for identifying areas subjected to flooding and the depth of flooding include: (1) flood hazard area photomaps; (2) flood profiles for the photomaps; (3) cross sections showing general valley and channel shapes; (4) discharge and elevation for selected floods; and (5) the description, elevation, and location for elevation reference marks. (Seigler-IPA)
W79-09479

FLOOD HAZARD ANALYSES: STEWARTS CREEK--LOVILLS CREEK, SURRY COUNTY, NORTH CAROLINA.
Soil Conservation Service, Raleigh, NC.
In cooperation with the North Carolina Department of Natural Resources and Community Development, Surry County Watershed Improvement Commission, June 1979. 154 p, 116 fig, 13 tab, 9 ref, 8 append.

Descriptors: *North Carolina, *Flood plains, *Land use, *Watersheds(Basin), Elevation, Mountains, Water levels, Urbanization, Aerial photography, Discharge(Water), Channels, Surface waters, Hydrographs, Drainage area, Flood control.

A flood plain study was conducted for Mount Airy and the surrounding area of Surry County to aid in developing a sound land use program. Stewarts Creek and Lovills Creek have their headwaters along the southern edge of the Blue Ridge Parkway in Carroll County, Virginia, and flow south to North Carolina and through Surry County to their confluence with the Ararat River. The area is a part of the South Atlantic Gulf Water Resources Region. The streams have cut rather narrow valleys ranging in depth from 50 to 300 feet below the level of the uplands. Stewarts Creek has a drainage area of 76 square miles and Lovills Creek has a drainage area of 36 square miles. Records show the June 14, 1947 flood to be the largest flood since 1904, when records were started. Development in the flood plain has occurred where the state road system crosses the flood plain. A well managed zoning ordinance can control this development so that flood damages will be minimal. Basic flood plain management measures are outlined. Data presented for identifying areas subject to flooding and the depth of flooding include: (1) flood hazard photomaps; (2) flood profiles for the maps; (3) cross sections showing general valley and channel shapes; (4) discharge and elevation for selected floods; and (5) the description, elevation, and location for elevation reference marks. (Seigler-IPA)
W79-09480

2F. Groundwater

APPROXIMATE WATER-LEVEL CHANGES IN WELLS IN THE CHICOT AND EVANGELINE AQUIFERS 1977-79, AND MEASURED COMPACTION 1973-79, IN HARRIS AND GALVESTON COUNTIES, TEXAS,
Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W79-09395

THERMAL GROUND-WATER DISCHARGE AND ASSOCIATED CONVECTIVE HEAT FLUX, BRUNEAU-GRAND VIEW AREA, SOUTHWEST IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 1A.
W79-09403

GEOPRESSURE IN THE CARRIZO-WILCOX AQUIFER SYSTEM OF TEXAS,
Geological Survey, NSTL Station, MS. Water Resources Div.
For primary bibliographic entry see Field 1A.
W79-09409

USE OF HYDROGEOLOGIC MAPPING TECHNIQUES IN IDENTIFYING POTENTIAL GEOPRESSURED-GEOTHERMAL RESERVOIRS IN THE LOWER RIO GRANDE EMBAYMENT, TEXAS,
Geological Survey, NSTL Station, MS. Water Resources Div.
For primary bibliographic entry see Field 1A.
W79-09410

WATER-TABLE MAP OF KENOSHA COUNTY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W79-09411

WATER-TABLE MAP OF MILWAUKEE COUNTY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W79-09412

WATER-TABLE MAP OF RACINE COUNTY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W79-09413

WATER-TABLE MAP OF WALWORTH COUNTY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W79-09414

WATER-TABLE MAP OF WAUKESHA COUNTY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W79-09415

HYDROGEOLOGY OF UNDERGROUND COAL MINES IN ILLINOIS,
Illinois State Geological Survey, Urbana.
K. Cartwright, and C. S. Hunt.
From: Proceedings of the International Symposium on Water in Mining and Underground Works, September 17-22, 1978, Granada, Spain. Reprint 1978 N, 21 p, 12 fig, 1 tab, 10 ref.

Descriptors: *Hydrogeology, *Illinois, *Coal mines, Groundwater, Pumpage, Conductivity, Piezometers, Hydraulic stress, Aquifers, Mine drainage, Tunneling, Subsidence, Rock properties, Salinity, Hydraulic gradients, Hydrostatic pressure, Stratigraphy.

Coal mines in the Illinois Basin Coal Field were studied to determine why they are generally 'dry' despite their locations in water-saturated rocks. There were exceptions, but most mines reported pumpage of less than 100 cubic meters per day. The hydrogeologic setting of the coal in this area is not affected by major tectonic deformations. Data from an abandoned well was obtained by observations during test borings, by examination of samples from cores, and by measurement of water levels in a series of piezometers set at different depths. An active well was also investigated using piezometers inserted in roof bolt holes in the roof of the mine. Three hydrogeologic settings in which water may be a problem in a mine are discussed. The most common setting is the situation where the mine approaches a buried distributary channel within the coal bearing rocks. Hydrogeologic results show that the low volumes of water from the studied mines are directly related to the extremely low hydraulic conductivity of the rock associated with the coal. (Seigler-IPA)
W79-09425

SULFIDE OXIDATION FRONT IN THE TUSCALOOSA AQUIFER AT THE SAVANNAH RIVER PLANT, SOUTH CAROLINA,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
I. W. Marine.
Available from the National Technical Information Service, Springfield, VA 22161 as DEMS-7672, Price codes: A02 in paper copy, A01 in microfiche. Presented at the 26th Annual Meeting of the Southeastern Section of the Geological Society of America at Winston-Salem, NC, March 25, 1977. 15 p, 3 fig, 2 tab. AT(07-2)-1.

Descriptors: *Savannah River Plant, *Dissolved oxygen, *Sulfates, South Carolina, Flow characteristics, Coastal plains, Saprolite, Clays, Aquifers, Hydrogeology, Groundwater movement, Limestone, Wells, Lithology, Acidic water, Water quality, Industrial water.

The inverse relationship of dissolved oxygen and dissolved sulfate in the waters of a coastal plain aquifer at the Savannah River Plant was investigated. The plant occupies approximately 300 square miles in south central South Carolina. It lies in the Atlantic Coastal Plain region (Aiken Plateau) and is dissected by tributaries of the Savannah River which forms its southwest border. The subsurface geology, hydrology, and lithology of the area are discussed. The Tuscaloosa aquifer is the primary industrial aquifer of the region. It ranges from 400 to 600 feet thick and produces over 1,000 gallons per minute from properly constructed wells. Water from the Tuscaloosa Formation is generally soft, acidic, and low in dissolved solids. Results show that where dissolved oxygen is about 8 parts per million (ppm), the sulfate content is less than 2 milligrams per liter (mg/l). Where dissolved oxygen is zero, the sulfate content is about 13 mg/l. The two areas of high and low oxygen content are distinctly separate and the boundary appears to be a sulfide oxidation front moving in the direction of groundwater flow. (Seigler-IPA)
W79-09426

2G. Water In Soils

MODIFICATIONS TO A SOIL OXYGEN DIFFUSION RATEMETER,
Maine Univ. at Orono. Northeast Plant, Soil, and Water Lab.
J. Bornstein, and M. McGuirk.
Soil Science, Vol. 126, No. 5, p 280-284, November, 1978. 1 fig, 5 ref.

Descriptors: *Aeration, *Soil gases, Oxygen, Laboratory equipment, Calibrations, Soil water.

Recent efforts to relate soil aeration to crop production rely in part on soil oxygen diffusion rate (ODR) measurements. The platinum microelectrode method is often used to measure the soil ODR. The electrode current is easily interpreted when the soil is saturated with water. When the soil is not saturated, the interpretation of the electrode current depends on the effective potential applied to the microelectrode. The effective potential cannot be measured directly, but is calculated from several other measured quantities. The equation for obtaining the effective potential is given for two types of ODR measurement systems. The second type is commercially available and offers several advantages, but has limited accuracy at low ODRs. Two modifications to the commercial system were described, both of which greatly increase the accuracy of the system. (Skogerboe-Colorado State)
W79-09503

2H. Lakes

PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERISTICS OF ROSS LAKE, SNOHOMISH COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
N. P. Dion.
Geological Survey Water-Resources Investigations 78-44 (open-file report), 1979. 15 p, 3 fig, 1 tab, 10 ref.

Descriptors: *Lakes, *Limnology, *Chemical properties, *Biological properties, Physical properties, Aquatic productivity, Thermocline, Bathymetry, Lake morphology, Lake morphometry, Nutrients, Dissolved oxygen, Bacteria, Coliforms, Aquatic plants, *Ross Lake(Wash), Tulalip Indian Reservation, Snohomish County.

A study of the physical, chemical, and biological characteristics of Ross Lake in 1975 showed that the lake has no well-defined surface-water inflow and that thermal stratification is well established in summer. The water is of a calcium bicarbonate type, which is typical of lakes in western Washington. Biological productivity in the lake was low, as indicated by low to moderate chlorophyll a concentrations, by the general lack of submerged plants on the lake bottom, and by the moderate dissolved-oxygen depletion in the deeper zones during thermal stratification. The productivity probably was limited by the amount of phosphorus available. Increased productivity and the resulting growth of nuisance plants in the lake can be avoided by limiting phosphate inputs to their present or lesser rates. (Woodard-USGS)
W79-09402

EFFECTS OF IMPOUNDMENT ON WATER AND SEDIMENT IN THE ARKANSAS RIVER AT PUEBLO RESERVOIR.
University of Southern Colorado, Pueblo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-269 664, Price codes: A08 in paper copy, A01 in microfiche. Report No. REC-ERC-76-19, May 1977. Prepared for Bureau of Reclamation, Engineering and Research Center, Denver, Colorado. 164 p, 24 fig, 4 tab, 22 ref, 4 append.

Descriptors: *Water quality, *Limnology, *Trace elements, Arkansas River, Pueblo Reservoir, Pueblo Dam, Water analysis, Dams, Reservoirs, Suspended solids, Pre-impoundment, Post-impoundment, Multiple-purpose reservoirs, Sediment load, Chemical wastes, Water pollution effects.

Water quality of the Arkansas River and the Pueblo Reservoir was studied from 1972 to 1976. Prior to impoundment, the Arkansas River was monitored for concentrations of major and minor inorganic chemicals (Ag, Cu, Fe, Mn, Zn, Co, Pb, Cd, Hg, Li, Na, K, Ni, Mg, and Ca) within the dissolved fraction and suspended fraction of water. Other limnological parameters examined included: dissolved oxygen, conductivity, pH, turbidity, alkalinity, sulfate, temperature, hardness, chloride, total dissolved solids, and total suspended matter. Pre-impoundment and impoundment sediments were analyzed and compared for K, Na, Ca, Mg, Li, Cu, Cd, Pb, Fe, Mn, Zn, and Mo. The dissolved and suspended concentrations of all the parameters averaged much less than the recommended or maximum permissible limits. Nearly ideal growth conditions for salmonid fishes were indicated by dissolved oxygen and temperature data. For most parameters interesting seasonal, surface, and spatial trends were observed; the most frequent seasonal trend was the classic high winter values (low discharge) and low summer values (high discharge). Trends for Fe, Mn, and Zn did not follow classical outlines. Data indicates that reservoir sediments near the inlet are being enriched in a number of trace metals (Fe, Mn, Zn, and perhaps Mg, Cu, Cd, and Pb). (Schaefer-IPA)
W79-09440

LAKE ONTARIO REGULATION,
Corps of Engineers, Buffalo, NY. Buffalo District.
W. P. Erdle.
Water Spectrum, Vol. 11, No. 2, p 17-25. Spring 1979. 10 fig.

Descriptors: *Lake Ontario, *Regulated flow, *Water control, *Water resources development, St. Lawrence River, Riparian rights, Hydroelectric power, Dams discharge(Water), Water levels, Inflow, Reservoirs, Evaporation, Seasonal, Navigable rivers, Government interrelations, Flood control, Plan 1958-D.

The history of man's attempts to regulate Lake Ontario and the complexities of developing a plan which fairly distributes the benefits of regulation among riparian shipping, and power interests are discussed. Prior to the 1950s Lake Ontario was regulated only by nature. To a great extent the lake remains regulated primarily by nature since she still determines the inflows, but the construction of the St. Lawrence Seaway and Power Development Project in the 1950s did give man some control of the outflows from the system. Extensive dredging was performed to provide enlarged channels for the deeper draft ocean vessel that would use the system and to allow for higher outflows through the river. Control structures, dams, were built to generate electrical power and regulate the outflow from the lake. A regulation plan, 1958-D, to prescribe the outflow to be released from the dams under various conditions of lake levels and inflows, has been in effect since October 1963. Other plans have been considered and mathematically tested, but none to date have appeared as satisfactory as Plan 1958-D. The regulation of Lake Ontario has reduced the detrimental impact of sustained periods of both high and low precipitation over the Great Lakes Basin for nearly two decades. (Seigler-IPA)
W79-09466

PHYTOPLANKTON WATER QUALITY RELATIONSHIPS IN U.S. LAKES, PART IV: GENERA HANTZSCHIA THROUGH PTEROMONAS COLLECTED FROM EASTERN AND SOUTHEASTERN LAKES,
Environmental Monitoring and Support Lab., Las Vegas, NV. Monitoring Operations Div.
V. W. Lambou, F. A. Morris, M. K. Morris, W. D. Taylor, and L. R. Williams.
Ecological Research Series, Report No. EPA-600/3-79-024, March 1979. Prepared for the U.S. Environmental Protection Agency, Office of Research and Development 112 p, 2 tab, 4 ref, 1 append.

Descriptors: *Phytoplankton, *Eutrophication, *Lakes, *Water quality, Phosphorus compounds, Nitrogen compounds, Chlorophyll, Turbidity, Secchi disks, Alkalinity, Aquatic microbiology, Nutrients, Plant growth, Hydrogen ion concentration.

Data are presented for the environmental requirements and relative abundance of 47 phytoplankton genera. The data are based on the water quality relationships for about 180 genera and 700 species of phytoplankton determined from the National Eutrophication Survey in 1973. The survey involved 750,000 physical and chemical measurements made in 250 lakes, in 17 states. Of the 180 genera in the survey, 47 (alphabetically from Hantzschia through Pteromonas) are summarized here. The summaries are organized according to numerical dominance or non-dominance and occurrence or non-occurrence. The summaries are computer generated and include categories of: chlorophyll a, turbidity, Secchi disks, pH, dissolved oxygen, temperature, total phosphorus, nitrogen, and others. The summaries provide knowledge of the specific requirements or environmental limits for each taxon, and are useful for the development of biological tools for monitoring and predicting water quality or trophic condition. Results show a lake population bias toward the eutrophic end of the trophic spectrum. (Seigler-IPA)
W79-09469

PHYTOPLANKTON WATER QUALITY RELATIONSHIPS IN U.S. LAKES, PART V: GENERA QUADRIGULA THROUGH ZYGNEMA COLLECTED FROM EASTERN AND SOUTHEASTERN LAKES,
Environmental Monitoring and Support Lab., Las Vegas, NV. Monitoring Operations Div.
M. K. Morris, W. D. Taylor, L. R. Williams, S. C. Hern, and V. W. Lambou.
Ecological Research Series, Report No. EPA-600/3-79-025, March 1979. Prepared for the U.S. Environmental Protection Agency, Office of Research and Development. 106 p, 2 tab, 4 ref, 1 append.

Descriptors: *Phytoplankton, *Eutrophication, *Lakes, *Water quality, Phosphorus compounds, Nitrogen compound, Chlorophyll, Turbidity, Secchi disks, Alkalinity, Aquatic microbiology, Plant growth.

Computer generated summaries of the environmental requirements and relative abundancies of 45 phytoplankton genera are presented. The data are based on the water quality relationships for about 180 genera and 700 species of phytoplankton determined from the National Eutrophication Survey in 1973. The survey involved 750,000 physical and chemical measurements in 250 lakes, in 17 states. Of the 180 genera in the survey, 45 (alphabetically from Quadrigula through Zygnema) are summarized. The summaries are organized according to numerical dominance or non-dominance and occurrence or non-occurrence. Summary measurement categories include: chlorophyll a, turbidity, Secchi disks, pH, dissolved oxygen, temperature, total phosphorus, nitrogen, and others. The summaries provide knowledge of the specific requirements of environmental limits for each taxon, and are useful for the development of biological tools for monitoring and predicting water quality or trophic conditions. Results show a lake population bias toward the eutrophic end of the trophic spectrum. (Seigler-IPA)
W79-09470

PHYTOPLANKTON WATER QUALITY RELATIONSHIPS IN U.S. LAKES, PART VI: THE COMMON PHYTOPLANKTON GENERA FROM EASTERN AND SOUTHEASTERN LAKES,
Environmental Monitoring and Support Lab., Las Vegas, NV. Monitoring Operations Div.
W. D. Taylor, S. C. Hern, L. R. Williams, V. W. Lambou, and M. K. Morris.
Ecological Research Series Report No. EPA 600/3-79-051, April 1979. Prepared for the U.S. Environmental Protection Agency, Office of Research and Development. 92 p, 5 fig, 5 tab, 29 ref, 2 append.

Descriptors: *Phytoplankton, *Water quality, *Lakes, *Eutrophication, *Aquatic microbiology, Biological indices, Algae, Chlorophyll, Seasonality, Light intensity, Turbidity, Secchi disks, Habitats, Phosphorus compounds, Nitrogen compounds.

Environmental conditions associated with the 57 most common genera of phytoplankton encountered in the National Eutrophication Survey of 250 lakes in 17 states during 1973 are analyzed and compared. The use of these phytoplankton as indicator organisms for monitoring water quality and/or the trophic condition of lakes is discussed. Most phytoplankton genera showed no distinct seasonality to their general occurrence, although some forms achieved numerical importance only during certain seasons. Flagellates and diatoms tended to dominate the spring plankton with blue-green and coccoid green most common in summer and fall. The physical and chemical lake data associated with the various occurrence categories (non-occurrence, non-dominance, and dominance) of common phytoplankton genera are summarized. These summaries can be used to develop biological tools for monitoring lake water quality or trophic state, and to suggest environmental control methods for problem algae. Study results show that the more common phytoplankton genera thrive over such a broad range of environmental conditions that no one genus is a dependable indicator of water quality or trophic conditions in lakes. However, the tendencies of some of the genera toward high or low ends of some parameters suggest a community-based trophic classification which 'sums the individual probabilities' of the genera to increase the resolution of trophic state estimates. (Seigler-IPA)
W79-09471

2I. Water In Plants

INFLUENCE OF PHOSPHORUS ON ZINC, IRON, MANGANESE, AND COPPER UPTAKE BY PLANTS,
California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.
A. Wallace, R. T. Mueller, and G. V. Alexander.
Soil Science, Vol. 126, No. 6, p 336-341, December, 1978. 3 tab, 28 ref.

Descriptors: Nutrient removal, *Nutrients, Zinc, Iron, Manganese, Copper, Phosphorus, *Plant growth, Beans.

Five cultivars of soybeans (Glycine max. L.) and a bush bean (Phaseolus vulgaris L. cv 'Improved Tendergreen') were grown in nutrient solutions with different P levels, solution pH, and, in the case of bush bean, at different Fe levels. The objective of the experiments was to obtain more definitive answers to problems of P-induced Zn and Fe deficiencies. Differential solution pH, obtained by adding solid phase CaCO3 to the nutrient solution (about pH 7) vs. a regular solution (about pH 4-5), indicates that pH is very important in the effects obtained. At high pH, increasing solution P decreased the leaf, stem, and root concentrations of Zn, Mn, and Cu in soybeans. Iron was decreased in roots, but not in leaves and stems. In contrast, at low pH, increasing the P resulted in more Zn, Mn, and Cu but less Fe in leaves, stems, and roots. Results with bush beans were only slightly different from those with soybeans, and the Zn-P effects were modified slightly by Fe levels. High P decreased Fe transport to leaves in bush beans at low and high pH, but only at the high Fe level. (Skogerboe-Colorado State)

W79-09497

2K. Chemical Processes

OXIDATIVE RELEASE OF POTENTIALLY MINERALIZABLE SOIL NITROGEN BY ACID PERMANGANATE EXTRACTION,
Science and Education Administration, Beltsville, MD. Biological Waste Management and Soil Nitrogen Lab.
G. Stanford, and S. J. Smith.
Soil Science, Vol. 126, No. 4, p 210-218, October, 1978. 6 fig, 2 tab, 13 ref.

Descriptors: *Nitrogen, Soil tests, *Organic matter, *Soil chemistry, Laboratory tests, Oxidation.

The relation of potentially mineralizable soil nitrogen, NO, to the oxidative release of NH4-N from soil organic matter during extraction with acid KMnO4 was investigated, using 62 soils. Included in the study were members of 8 soil orders comprising 43 noncalcareous and 19 calcareous soils. Soils were extracted with 1 N H2SO4 solutions of 0.05 and 0.1N KMnO4 (HOx) and with 1 N H2SO4 (H) alone for 1 h at room temperature, and amounts of NH4-N released were determined. The expression HOx - H denotes the quantity of NH4-N released owing to partial oxidation of soil organic matter. Later, a more direct and simpler procedure for determining oxidative NH4-N release was adopted, in which soils were preextracted with 1 N acid, and the soil residues were extracted with acidic KMnO4. Regression equations that may be useful in predicting NO from the oxidative release of NH4-N were developed. Amounts of NH4-N released by oxidation with 1 N H2SO4 solutions of 0.05 and 1.0 N KMnO4, respectively, were approximately one-third and one-half of NO. It was concluded that the NH4-N was derived from oxidation of the soil organic N fraction most readily susceptible to biological mineralization. (Skogerboe-Colorado State)
W79-09491

EVALUATION OF AMMONIUM RELEASE BY ALKALINE PERMANGANATE EXTRACTION AS AN INDEX OF SOIL NITROGEN AVAILABILITY,
Science and Education Administration, Beltsville, MD. Biological Waste Management and Soil Nitrogen Lab.
G. Stanford.
Soil Science, Vol. 126, No. 4, p 244-253, October, 1978. 1 fig, 4 tab, 27 ref.

Descriptors: *Nitrogen, *Soil chemistry, *Organic matter, Laboratory tests, Hydrolysis, Oxidation.

The relation of potentially mineralizable soil nitrogen, NO, to hydrolytic and oxidative release of NH4-N from soil organic matter by extraction with alkaline permanganate was investigated using 62 soils representing several major agricultural regions in the United States. The NH4-N was recovered by steam-distilling 1-g samples of soil during extraction for 4 min with several concentrations of NaOH and KMnO4 in different combinations. The same concentrations of NaOH, without KMnO4, were used to determine amounts of NH4-N released by hydrolysis (B) during steam distillation. Oxidative release was estimated as the difference between total NH4-N produced during alkaline permanganate extraction (BOx) and that derived by NaOH distillation. With few exceptions, correlations of NO with BOx were as good as, or better than, simple correlations of NO with B or (BOx - B). Thus, the extra effort required for separate NaOH and NaOH-KMnO4 extractions did not appear to be justified. It was concluded that the alkaline permanganate methods thus far reported by various investigators, as well as modifications evaluated in this study, offer a less precise and reliable basis for predicting NO than does acid permanganate extraction for measuring oxidative release of NH4-N. (Skogerboe-Colorado State)
W79-09492

INFLUENCE OF PHOSPHORUS ON ZINC, IRON, MANGANESE, AND COPPER UPTAKE BY PLANTS,
California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.
For primary bibliographic entry see Field 2I.
W79-09497

EFFECT OF SULFATE IONS ON THE STABILITY AND EXCHANGE CHARACTERISTICS OF AN ALUMINUM-INTERLAYERED WYOMING BENTONITE,
Department of Agriculture, Ottawa (Ontario). Soil Research Inst.
S. S. Singh, and N. M. Miles.
Soil Science, Vol. 126, No. 6, p 323-329, December, 1978. 2 fig, 4 tab, 16 ref.

Descriptors: *Bentonite, Suspension, Clay minerals, *Sulfates, Chemical precipitation, X-ray diffraction, Chemical properties, *Soil chemistry.

Aluminum-interlayered, Wyoming bentonite suspensions, containing different amounts of precipitated Al, were equilibrated with SO4 solutions at different concentrations. The amount of Al precipitated as Al-hydroxy complex was 400, 550, and 750 me/100 g clay, and the concentration of SO4 in solution was 10, 20, and 30 me/1. On equilibration, the hydroxy-Al interlayer precipitate in the Wyoming bentonite reacted with SO4 ions, and a neutral precipitate of aluminum hydroxy sulfate was formed. Heating the Wyoming bentonite to 700 C resulted in complete collapse, showing that the precipitate was no longer present in the interlayer space. A crystalline compound of aluminum hydroxy sulfate was formed as evidenced by x-ray diffraction patterns. In the case of Al-interlayered, Wyoming bentonite suspensions that were not equilibrated with SO4 solution, the Al-hydroxy precipitate remained in the interlayer space and blocked the exchange sites. Treatment of these samples with SO4 solutions resulted in an increase of exchange capacity that was concentration-dependent. (Skogerboe-Colorado State)
W79-09498

SPATIAL VARIABILITY OF SOLUBLE SALT CONTENT IN A MANCOS SHALE WATERSHED,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
R. J. Wagenet, and J. J. Jurinak.
Soil Science, Vol. 126, No. 6, p 342-349, December, 1978. 4 fig, 2 tab, 11 ref.

Descriptors: Salinity, Saline water, *Saline soils, Spatial distribution, Colorado River Basin, Sampling, Statistical methods, Soil chemistry.

A study was conducted to examine data collected in the microwatershed land process studies with regard to quantifying spatially variable soil properties. All 35 sampling sites were classified as occurring on the Mancos shale formation within a 777 sq km (300 sq mi) area of the Price River Basin. Samples were taken at 0-2.5, 2.5-7.5, and 7.5-15.0-cm depths. Using the electrical conductivity (EC) of either the 1:1 or saturation extract as the salinity index parameter, it was found that EC values were distributed log-normally about the mean EC value of 35 observations. The coefficient of determination for the log-normal statistical plots was 1.00 for all three depths sampled at the 35 sites. The variance in the EC values increased with depth. (Skogerboe-Colorado State)
W79-09499

2L. Estuaries

BASIC INVESTIGATIONS FOR REMOTE SENSING OF COASTAL AREAS,
Environmental Research Inst. of Michigan, Ann Arbor.
R. A. Shuchman, F. J. Thomson, and D. R. Lyzenga.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A027 468, Price codes: A02 in paper copy, A01 in microfiche. Quarterly Report 108900-7-L, July 1976. 23 p, 2 fig, 1 tab, 5 ref, 2 append. ONR N00014-74-C-0273.

Descriptors: *Beaches, *Coasts, *Remote sensing, *Model studies, Mathematical models, Planning, Reflectance, Analytical techniques.

During the quarterly period 1 April-15 July 1976, four activities took place. The second year interim report was extensively revised using comments from the sponsor and ERIM personnel and currently is in printing. A detailed program plan for 1974 ONR activities was written and distributed internally to key ERIM personnel for review. Work has commenced on obtaining critical optical properties of beach minerals needed as inputs into the Beach Environment model. In the water modeling area, work is progressing along two fronts: (1) a computer program has been written to implement a combined water-atmosphere model, and (2) further theoretical work has indicated a small correction to be made to the existing QSS model. (Sims-ISWS)
W79-09525

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALINATION PROCESS SYSTEM AND BY-PRODUCT RECOVERY,
Stone and Webster Engineering Corp., Boston, MA. (Assignee).
F. E. Conger.
U.S. Patent No. 4,141,825, 9 p, 2 fig, 5 ref; Official Gazette of the United States Patent Office, Vol. 979, No. 4, p 1426, February 27, 1979.

Descriptors: *Patents, *Water treatment, *Desalination, *Desalination apparatus, Reverse osmosis, Electrodialysis, Separation techniques, Brackish water, Saline water, Byproducts, Byproduct recovery.

The process system of the invention relies essentially on an electrodialysis installation in series (including recycle) with a reverse osmosis installation and with one or more brine concentrator methods and also with by-product recovery systems. The system processes pretreated brackish water in an electrodialysis subsystem to produce (1) product water and (2) moderately saline water of higher salt content than the entering brackish water. The moderately saline water is then processed in a reverse osmosis subsystem to product (3) product water, (4) brackish water and (5) brine. The brine is processed in brine concentration/by-product subsystems consisting of mechanical brine concentrators such as R.C.C. and solar ponds and molten salt units to produce distilled product water, by-products and discard. (Sinha-OEIS)
W79-09511

MEMBRANE SEPARATION OF WATER FROM AQUEOUS MIXTURES,
Monsanto Co., St. Louis, MO. (Assignee).
For primary bibliographic entry see Field 5G.
W79-09520

CELLULOSE ESTER ULTRA-FILTRATION MEMBRANES AND THEIR MANUFACTURE,
Canadian Patents and Development Ltd., Ottawa (Ontario). (Assignee).
O. Kutowy, W. L. Thayer, and S. Souriajan.
U.S. Patent No. 4,145,295, 9 p, 4 fig, 4 tab, 7 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 3, p 1019, March 20, 1979.

Descriptors: *Patents, *Membranes, *Semipermeable membranes, Filtration, Polymers, Desalination processes, Water pollution treatment, *Manufacturing processes, Ultrafiltration techniques.

This invention relates to cellulosic-ester semi-permeable membranes, and their preparation and more particularly to semi-permeable membranes for use

in ultra-filtration techniques such as in the desalination of sea water, and in the removal of salts, such as nickel chloride, from the effluent of plating processes and the like. The process for producing the membrane is described where a thin film is cast from a mixture comprising cellulosic ester polymer, pore forming additive and casting solvent. A portion of the casting solvent is removed from the film and the film is immersed in a geletion bath containing a polar organic compound which is miscible with the casting solvent. The improvement comprises controlling the temperature of the gelation bath at a selected temperature in the range -20 degrees C to + 30 degrees C and selecting the concentration of the polar compound in the gelation bath to be greater than that required to produce the initial minimum flux for the membrane. (Sinha-OEIS)
W79-09540

3B. Water Yield Improvement

GRAVITY-FED WATER SYSTEMS IN MINES,
Chambers of Mines, Johannesburg (South Africa). Environmental Engineering Lab.
A. Whillier, and J. Van Der Walt.
Journal of the South African Institute of Mining and Metallurgy, Vol. 77, No. 9, p 187-192, April 1977. 6 fig, 1 tab.

Descriptors: *South Africa, *Water shortage, *Dependable supply, *Water supply, *Piping system(Mechanical), *Hydrologic aspects, Water demand, Water sources, Pipes, Goose-neck inlets, Gages, Flow friction, Pipelines, Dams, Expansion, Shafts(Excavations), Gravity, Swirl.

Primary causes of water shortages in South African mines and some of the fundamental hydraulic principles that must be followed in gravity-fed water systems to alleviate the problems are discussed. Water shortages in mines as a result of underground dams running dry are significant due to losses in production because shortages have occurred during fire-fighting operations, and due to the increasing need of water for cooling. The major problem is that the construction of underground dams and pipes leading from the dams do not follow sound hydraulic practice. Six major principles of hydraulics are discussed in relation to water pipeline systems in mines. Topics covered include: pipe size, goose-neck inlets, flow capacity, swirl prevention, underground dam height, intermittent flow, and thermal expansion. Instructions are provided to aid in pin-pointing trouble in a system with simple pressure gauge measurements. Diagrams and calculations to illustrate the various hydraulic principles are included. (Siegler-IPA)
W79-09441

3C. Use Of Water Of Impaired Quality

SPATIAL VARIABILITY OF SOLUBLE SALT CONTENT IN A MANCOS SHALE WATERSHED,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
For primary bibliographic entry see Field 2K.
W79-09499

PROCESS FOR GAS CLEANING WITH RECLAIMED WATER AND APPARATUS FOR WATER RECLAMATION,
Texaco Inc., New York. (Assignee).
C. P. Marion, L. E. Estabrook, and G. N. Richter.
U.S. Patent No. 4,141,696, 13 p, 2 fig, 1 tab, 2 ref; Official Gazette of the United States Patent Office, Vol. 979, No. 4, p 1388, February 27, 1979.

Descriptors: *Patents, *Reclaimed water, *Impaired water use, Water treatment, Water reuse, Separation techniques, Flash distillation, Equipment.

Dispersions comprising water and particulate solids, i.e. carbon and ash, are produced in at least one gas cooling or scrubbing zone by quench cooling or scrubbing the raw gas stream from a partial oxidation gas generator with water. The dispersions are resolved by liquid extraction in a decanting zone to produce a water layer containing carbon, dissolved gas, and ash, and also a separate dispersion comprising carbon, extractant, and water. Solids-free water and liquid extractant are then separated for the dispersion in a distillation zone. This water is introduced on to a stripping plate of a flash column along with solids-free recycle condensate from the flash column. The solids-containing water from the decanting zone is flashed below the stripping plate and a portion is converted into steam. The steam passes up through holes or bubble caps in the stripping plate and is dispersed through the water contained on the plate. If desired, a portion of the water obtained from blowing-down a gas cooler may be flashed to steam below the stripping plate. Unvaporized water falls to the bottom of the column. A vertical weir separates the flash column at the bottom into two chambers. Solids settle out of the water in the first chamber and clarified water flows over the weir into the second chamber. Overflow water from the stripping plate is discharged below the water-level in the second chamber by way of a down-comer. Reclaimed water is pumped to the gas cooling and scrubbing zones from the second chamber, and waste water containing solids in the first chamber is discharged from the system. (Sinha - OEIS)
W79-09508

3F. Conservation In Agriculture

METHODOLOGIES FOR VALUATION OF AGRICULTURAL CROP YIELD CHANGES--A REVIEW,
Eureka Labs., Inc., Sacramento, CA.
For primary bibliographic entry see Field 6B.
W79-09489

POLLUTION CONTROL MANUAL FOR IRRIGATED AGRICULTURE,
Toups Corp., Loveland, CO.
K. Kepler, D. Carlson, and W. T. Pitts.
Publication No. EPA-908/3-78-002, August, 1978. 213 p, 30 fig, 28 tab, 131 ref, 4 append.

Descriptors: Water pollution control, *Agriculture, *Return flow, *Salinity, Sediment, *Nitrates, Pesticides, Salt balance.

The manual is intended to expand understanding of irrigated agriculture-water quality relationships to a broad group, including water quality interests, water resource interests, and agricultural field technicians. Collecting pertinent information on the irrigation system, sampling techniques, and evaluation techniques for determining the water quality impacts of return flows, combined with beneficial use aspects allow irrigation to be put into perspective with other elements of a water quality plan. Development of best management practices (BMP's) incorporates this water quality information plus information on the various agricultural practices. Understanding of local conditions affecting BMP's can be developed within the evaluation framework. Technical information on irrigated agricultural practices and the pollutants associated with return flows is presented in a manner which makes it available to the layman as well as to experienced personnel. Traditional and recently developed irrigation practices are developed and evaluated in terms of use, pollutant loading pathways, cost, and effectiveness. Pollutants are discussed in terms of occurrence in nature, loading mechanisms, evaluation techniques, and effect upon beneficial use. (Skogerboe-Colorado State)
W79-09490

AUTOMATION OF AN OPEN-DITCH IRRIGATION CONVEYANCE SYSTEM UTILIZING TILE OUTLETS,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
L. J. Erie, and A. R. Dedrick.
Transactions of the American Society of Agricultural Engineers, Special Edition, Vol. 21SW, No. 1, p 119-123, February 20, 1978. 6 fig, 6 ref.

Descriptors: *Irrigation ditches, Automation, *Automatic control, Tiles, Conveyance structures.

Nearly 80% of the irrigated lands in the United States use surface irrigation techniques. Most of the on-farm, irrigation-water distribution systems are of the open-ditch type. The latest trend in western Arizona and parts of California is to deadlevel fields, then irrigate from single or multiple outlets with large streams of water. These level basins are well adapted to automation. An automated irrigation system reduces farm labor requirements and, as an irrigation management tool, can reduce water application, improve crop production, and minimize scalding and thus stand loss. A 28.4-ha (70-acre) field irrigated with tile outlets was pneumatically automated using two types of pillows on the outlet side, in combination with automated jack-gates, from a centrally located concrete-lined canal. The present system is being used by the farmer, observed and amended by the researchers, and demonstrated to many U.S. and foreign visitors. (Skogerboe-Colorado State)
W79-09493

GROUND-WATER CONTAMINATION BY FERTILIZER NITROGEN,
Science and Education Administration, Fort Collins, CO.
For primary bibliographic entry see Field 5B.
W79-09494

AUTOMATION OF ON-FARM IRRIGATION TURNOUTS UTILIZING JACK-GATES,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
A. R. Dedrick, and L. J. Erie.
Transactions of the American Society of Agricultural Engineers, Special Edition, Vol. 21SW, No. 1, p 92-96, February 20, 1978. 6 fig, 3 tab, 7 ref.

Descriptors: *Surface irrigation, Automation, Automatic control, Turnouts.

The design, development, and installation of equipment used to automate existing single outlet turnouts (jack-gates) on a 26.3-ha (65-acre) field were described. Specific jack-gate modifications and equipment requirements; control center design associated with safety overflow, excess water after irrigation, and sequencing functions; and system operations were discussed. (Skogerboe-Colorado State)
W79-09495

DEVELOPMENT AND EVALUATION OF EVAPOTRANSPIRATION MODELS FOR IRRIGATION SCHEDULING,
Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 2D.
W79-09496

SHOULD INTEGRATE PEAK LOAD WITH WATER MANAGEMENT,
Irrigation Age, Vol. 13, No. 1, p 64, September, 1978. 1 fig.

Descriptors: Irrigation practices, *Irrigation efficiency, Pumping, *Sprinkler irrigation, Water reuse, Center pivot systems, Water pressure, Farm equipment, Fertilizers.

Center pivot irrigators who rely on electricity could save up to $72 million a year if more 'integrated' peak electrical load and water management control systems were designed. And, the technical knowledge is available. At the same time, power suppliers would be able to more successfully deal with the problems of high peak electrical demands. The problem is that short term peaks require generation and transmission facilities that are underutilized during much of the year. Key to success with an integrated approach is that irrigation scheduling techniques, geared to saving both water and energy, would be used. Savings in nitrogen, pumping costs and system wear could amount to

another $60 million annually with better water management. (Skogerboe-Colorado State)
W79-09502

IRRIGATION SYSTEM AND IMPROVEMENT STRUCTURE THEREIN,
B. Courtright.
U.S. Patent No. 4,142,547, 8 p, 14 fig, 5 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 1, p 105, March 6, 1979.

Descriptors: *Patents, *Irrigation, *Irrigation systems, *Irrigation practices, Irrigation efficiency, Mechanical equipment, Automatic control, Prime mover, Torquing gear.

An agricultural irrigation system includes a prime mover or structural means to apply torque directly to an irrigation wheel line advancing it over a field. Means are provided the prime mover or associated structure so as to sense wheel line deflections, i.e., to sense whether or not the prime mover is leading or lagging a portion of the line. The translation means of the prime mover is driven independently of the torquing gear, and the ratio of the speeds of both is adjusted or varied automatically in response to the direction and degree of deflection of the wheel line relative to its nominal intended position. The adjustment occurs automatically so that the prime mover will automatically catch-up or slow-down to bring the line into its intended configuration, usually rectilinear. This is accomplished by reciprocating hydraulic jacks with associated structure to revolve the torquing gear of the wheel line and the capstan of the prime mover independently. Suitable valving means and appropriate linkage is made responsive to wheel line deflection for adjusting the pressure flow to such jacks, thereby automatically controlling and varying the speed of revolvement of the torquing gear and/or capstan as needed. (Sinha - OEIS)
W79-09518

CONTROL FOR ROTATING ARM IRRIGATION SYSTEM,
A. R. Orcutt.
U.S. Patent No. 4,142,548, 5 p, 3 fig, 5 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 1, p 105, March 6, 1979.

Descriptors: *Patents, *Irrigation systems, *Irrigation practices, *Irrigation efficiency, Control systems, Water pressure, Valves, Application equipment.

A control for a motor driven rotating arm crop irrigation system of the type having a low pressure control for stopping the water supply pump includes a normally closed discharge valve adjacent the supply connection to the arm. A control responsive to malfunction of the arm drive opens the discharge valve to release water and thereby decreases the pressure in the supply line; this lowers the pressure at the low pressure control of the supply which then operates to shut off the water supply. The power for the malfunction control including the discharge valve operation is supplied by a battery located adjacent the arm pivot and no electric power supply or control wires are required between the pivot area and the water supply equipment. (Sinha - OEIS)
W79-09519

EMITTER FOR DRIP IRRIGATION SYSTEMS,
E. M. Bright, Sr.
U.S. Patent No. 4,143,820, 10 p, 10 fig, 7 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 2, p 530, March 13, 1979.

Descriptors: *Patents, *Irrigation, *Irrigation practices, *Irrigation efficiency, Flow, Water pressure, Application equipment, Cleaning, Drip irrigation, Flushing, Emitters.

A temperature insensitive, low cost, pressure regulating and remotely flusable emitter for drip irrigation systems comprises a nodal body insertable into the wall of a pipe and having an end face aperture in which a deflectable resilient element responds to interior water pressure changes. The resilient element is deflectable normally to the plane of the end face, and provides at least one edge surface in facing, shearing relation to the end face aperture wall. In a first mode, one or more slip apertures decrease in area in response to increases in interior water pressure within a nominal operating range. When the pressure is raised further, however, the resilient element is deflected across the end face aperture wall, to define at least one slip aperture providing a low volume by high velocity flow which creates a flushing or cleaning action. In a preferred form of structure, the end face of the nodal body is substantially parallel to the flow direction in the pipe and is thicker than the resilient strip, which has at least a double curvature that provides controlled deflection. Water flow along the pipe and the short path length through the aperture tend to prevent clogging, reducing the need for filtration equipment. (Sinha - OEIS)
W79-09524

METHOD AND COMPOSITION FOR IMPROVING THE FUNCTIONING OF DRIP IRRIGATION SYSTEMS,
Fertilizers and Chemicals Ltd., Haifa (Israel). (Assignee).
A. Gulko, and D. S. Greidinger.
U.S. Patent No. 4,145, 208, 5 p, 6 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 3, p 992, March 20, 1979.

Descriptors: *Patents, *Irrigation, *Irrigation practices, *Application methods, Irrigation efficiency, Fertilization, Nitrogen compounds, Ureas, Disinfection, Scaling, *Drip irrigation, Emitter clogging.

A method for improving the smooth functioning of drip irrigation utilizes some nitrogen-based compositions. The method consists in providing to the solution supplied to drip irrigation, a pH from about 0.05 to about 3.0, utilizing an aqueous solution of urea nitrate having a weight concentration from about 28 to 0.1 percent respectively. The urea nitrate may also be considered a valuable rich nitrogen fertilizer, being completely available to plants. Since by its dissolution in water it results in an acidic pH, it was found that it would be particularly suitable for drip irrigation fertilization giving rise to a controlled source of nitric acid. By it slow release of acidity, it will reopen or avoid any eventual clogging of the emitters by precipitates. Such precipitates are caused by dissolved minerals that come out of solution due to a change in pH or temperature, and from the crust formed inside the pipes and emitters which will first slow the flow and ultimately cause full clogging. Urea nitrate will also have a beneficial effect against common bacteria acting as a disinfectant agent. (Sinha - OEIS)
W79-09530

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

FLOOD PLAIN INFORMATION: RED LAKE RIVER, CROOKSTON, MINNESOTA,
Army Engineer District, St. Paul, MN.
For primary bibliographic entry see Field 2E.
W79-09338

SPECIAL FLOOD HAZARD INFORMATION: SOUTH BRANCH ROOT RIVER AT PRESTON, MINNESOTA,
Army Engineer District, St. Paul, MN.
For primary bibliographic entry see Field 2E.
W79-09339

FLOOD PLAIN INFORMATION: SNAKE RIVER, CITY OF WARREN, MINNESOTA,
Army Engineer District, St. Paul, MN.
For primary bibliographic entry see Field 2E.
W79-09340

FLOOD HAZARD INFORMATION: DOLORES RIVER AND TRIBUTARIES, DOLORES, MONTEZUMA COUNTY, COLORADO,
Army Engineer District, Sacramento, CA.
For primary bibliographic entry see Field 2E.
W79-09341

ECONOMIC BENEFITS FROM INSTREAM FLOW IN A COLORADO MOUNTAIN STREAM,
Colorado State Univ., Fort Collins. Dept. of Economics.
For primary bibliographic entry see Field 6B.
W79-09416

WETLANDS AND FLOODPLAIN PROTECTION,
For primary bibliographic entry see Field 6E.
W79-09447

CUTTING FUTURE LOSSES: DROUGHT SPURS FEDERAL WATER POLICY REVIEW,
For primary bibliographic entry see Field 6E.
W79-09449

THE HYDRILLA MENACE,
B. Norton.
Water Spectrum, Vol. 11, No. 2, p 35-43, Spring 1979. 8 fig.

Descriptors: *Hydrilla, *Florida, *Aquatic weeds, *Aquatic weed control, Plant growth, Eutrophication, Harvesting, Navigable waters, Dredging, Trichanolamine, Diquat, Copper compounds, Plant physiology, Reproduction, White Amur, Moths, Plant diseases, Fusarium.

Various treatment methods to stop the spread of the aquatic weed, hydrilla are discussed. Hydrilla is an exotic water weed similar to Elodea that was probably inadvertently introduced into a waterway in Florida near Miami in 1960. It now infests nearly 700,000 aquatic acres in the United States. It blankets Florida, extends north to Iowa, west to California, and is still expanding. Hydrilla is negatively heliotropic, it normally grows downward away from the sun and expands laterally. By the time it appears near the surface it has already been laying tubers in the substrate for up to three years. It can choke an entire waterway, hasten eutrophication, and cause the waterway to die. Mechanical harvesting as a treatment method requires intensive labor, is time consuming, and is not highly effective. Harvesting methods include pulling, raking, digging, draining, and dredging. Applications of chemicals are a common and relatively effective control method. They provide a long-lasting control, are less labor-intensive, and are generally easy to apply, however they do not eliminate the problem because of their ineffectiveness in attacking root systems. Biological controls, the introduction of an exotic species to attempt to control the hydrilla, may cause additional threats, but several possibilities are promising. No single method has been found to stop the hydrilla march and integration of methods provides only slightly better results. (Seigler-IPA)
W79-09468

MULTILEVEL APPROACH TO URBAN STORM WATER SYSTEMS PLANNING,
Purdue Univ., Lafayette, IN.
For primary bibliographic entry see Field 6A.
W79-09488

4B. Groundwater Management

PLAN OF STUDY FOR THE NORTHERN MIDWEST REGIONAL AQUIFER-SYSTEM ANALYSIS,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 6A.

W79-09401

SHOULD INTEGRATE PEAK LOAD WITH WATER MANAGEMENT,
For primary bibliographic entry see Field 3F.
W79-09502

4C. Effects On Water Of Man's Non-Water Activities

A PHANTOM DOCTRINE: THE ORIGINS AND EFFECTS OF JUST V. MARINETTE COUNTY (CONTROL OF LAKE SHORE EROSION THROUGH FILL PERMITS),
Minnesota Univ., Minneapolis.
For primary bibliographic entry see Field 6E.
W79-09457

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

NATIONAL PROGRESS IN CONTROL OF WASTEWATER FROM COAL CONVERSION PROCESSES,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5C.
W79-09543

ORGANIC CONSTITUENTS OF WATERS ASSOCIATED WITH COAL AND OIL-SHALE CONVERSION,
Research Triangle Inst., Research Triangle Park, NC.
E. D. Pellizzari, and N. P. Castillo.
In: Proceedings of the Symposium on Potential Health and Environmental Effects of Synthetic Fossil Fuel Technologies, September 25-28, 1978. Oak Ridge, Tennessee, CONF-780903. p 57-69, July 1979. 4 fig, 4 tab, 4 ref. 68-03-2368.

Descriptors: *Water pollution, *Oil shales, Energy conversion, Coals, Effluents, Fossil fuels, Organic compounds, Coal gasification, Coal conversion technology.

Aqueous samples from in situ and low-Btu coal gasification processes and from in situ oil-shale retorting experiments were analyzed for volatile and semivolatile constituents. A comparison of the organic composition in water from Hoe Creek, Hanna II (In situ methods) and low-Btu gasification processes showed a striking similarity in oxygenated organics with the principal difference being in their concentration. Furans and ethers were not detected in the in situ processes. Nitrogen-containing organics were absent in the low-Btu sample. Concentration of aromatics was higher in the Hanna II sample. In the semivolatile organics, phenols constituted the major percentage of all organics. A greater diversity of phenolic isomers as well as a series of carboxylic acids was detected in the Hoe Creek I sample. Organic composition of waters from in situ oil-shale processes are listed in a table. (See also W79-09541) (Chilton-ORNL)
W79-09544

TRACE ELEMENTS IN THE SOLVENT REFINED COAL PROCESSES, SRC I AND SRC II,
Washington State Univ., Pullman. Dept. of Chemistry.
R. H. Filby, and S. R. Khalil.
In: Proceedings of the Symposium on Potential Health and Environmental Effects of Synthetic Fossil Fuel Technologies, September 25-28, 1978, Oak Ridge, Tennessee, CONF-780903. p 102-115, July 1979. 2 fig, 21 tab, 18 ref.

Descriptors: *Water pollution, Trace elements, Fossil fuels, Energy conversion, Waste water treatment, Water pollution treatment, Coals, Effluents, Mercury, Selenium, Arsenic, Coal conversion technology, Solvent refined coal process.

In SRC I and SRC II processes, water is produced as a reaction product and is also used as a quenching agent. These process waters contain trace metals from a number of sources in addition to hydrogen sulfide and soluble organic compounds. The treatment process in SRC I and SRC II involves flocculation with aluminum hydroxide, biodegradation of organic species, and filtration through activated charcoal. Although this treatment is designed primarily to remove organic species, it is also effective in reducing toxic trace element levels. The process water contains elevated levels of Hg, Se, and As and these levels are reduced to essentially background levels by the treatment process. (See also W79-09541) (Chilton-ORNL)
W79-09545

CHEMICAL SPECIATION OF HEAVY METALS IN POWER PLANT ASH POND LEACHATE,
Notre Dame Univ., IN. Dept. of Civil Engineering.
T. L. Theis, and R. O. Richter.
Environmental Science and Technology, Vol. 13, No. 2, p 219-224, February 1979. 7 fig, 4 tab, 15 ref.

Descriptors: *Water pollution, *Pollutant identification, Heavy metals, Powerplants, Fly ash, Chemistry, Chemical precipitation, Adsorption, Chemical speciation.

Measurements were made on samples from an active power plant fly ash disposal site and the data are organized via a thermodynamic approach which is facilitated by computer solutions to the equilibrium situation. Results of sample analysis showed that adsorption onto hydrous iron and manganese oxides is the major solubility control for cadmium, nickel, and zinc. In contrast, the solubilities of chromium, copper, and lead are controlled by discrete precipitates while adsorption is of diminished importance. The partitioning of metals between the soluble and particulate phases is strongly influenced by solution pH and to a lesser extent by complex forming ligands. (Chilton-ORNL)
W79-09573

5B. Sources Of Pollution

HYDROLOGIC CHARACTERISTICS OF THE LOS ALAMOS WELL FIELD, WITH REFERENCE TO THE OCCURRENCE OF ARSENIC IN WELL LA-6,
Los Alamos Scientific Lab., NM.
W. D. Purtymun.
Available from the National Technical Information Service, Springfield, VA 22161 as LA-7012-MS, Price codes: A04 in paper copy, A01 in microfiche. Report No. UC-11, Informal Report LA-7012-MS, November 1977. 63 p, 27 fig, 54 tab, 10 ref, 9 append. W-7405-Eng.36.

Descriptors: *Aresenic compounds, *Well data, *Hydrologic data, Water pollution, Pumping, Aquifer management, Water supply, Permeability, Water quality standards, Chlorides, Fluorides, Boosters, Lithologic logs, Logging(Recording), Sands, Sampling, Clays.

The results of arsenic concentration studies on well LA-6 are summarized and interpreted. LA-6 is one of six wells ranging in depth from 870 to 1965 ft that are completed in the Tesuque formation, the main aquifer of the Los Alamos area. Two unsuccessful attempts were made to reduce the aresenic concentration in LA-6 which began to increase in 1974 and early 1975. The first attempt was to determine which zone of the aquifer was yielding the high arsenic concentration. Water samples were collected at selected depths within the well, analyzed, and compared to geophysical logs. A high concentration of arsenic occurs throughout the aquifer adjacent to the well and the isolation attempt failed. Studies were also made of the possibility of reducing the arsenic concentration by using a combination of wells and restricting pumpage from LA-6. Test results were not satisfactory and LA-6 was placed on 'standby' to be used only in extreme emergency. The hydrologic characteristics of the wells in the Los Alamos well field are summarized and data from the well tests and related studies are provided. (Seigler-IPA)
W79-09429

THE CLEAN WATER ACT OF 1977: EXPANDED COMPETENCE OVER VESSEL-SOURCE POLLUTION,
Virginia Univ., Charlottesville.
For primary bibliographic entry see Field 6E.
W79-09459

GREAT LAKES WATER QUALITY: SEVENTH ANNUAL REPORT, APPENDIX D: ANNUAL REPORT OF THE RADIOACTIVITY SUBCOMMITTEE,
International Joint Commission-United States and Canada, Windsor (Ontario). Radioactivity Subcommittee.
Submitted to the Implementation Committee, Great Lakes Water Quality Board, July 1979. 107 p, 6 fig, 38 tab, 48 ref, 1 annex.

Descriptors: *Lake Huron, *Lake Michigan, *Lake Erie, *Lake Ontario, *Lake Superior, *Water quality, *Radioactivity, Radioactive wastes, Water pollution, Reactors, Power generation, Nuclear fuel cycles, Waste storage, Core melt, Sludge, Effluents, Radionuclides.

Detailed information and data available as of May 1979 regarding radioactivity in the Great Lakes Basin are presented. The 13 nuclear generating stations in the basin with their 22 reactors have a total installed electrical generating capacity of 14,807 megawatts. The water quality objective for radioactivity is assessed, and significant changes for converting between dose and concentration are discussed. To describe the impact of nuclear fuel cycle activities on the basin, an overview of each step of the nuclear fuel cycle is presented with particular attention given to waste management, including the regulations and options for waste storage and disposal. The potential radiological impact on the Great Lakes Basin for each step, for both normal and abnormal operation, is considered to the extent possible. Radiological risk is also evaluated. Present fuel cycle activities, the specific impact of each, and their present waste management practices are described. Releases of radionuclides from nuclear facilities in the basin are tabulated for 1978. Amounts of radionuclides detected in the sludge and effluent of municipal sewerage plants are also reported. The overall radiological quality of the Great Lakes was essentially unchanged from 1977. Differences in the reported levels of radioactivity for the open lakes were not large and were not consistent enough to support long-term projections. (Seigler - IPA)
W79-09476

GROUND-WATER CONTAMINATION BY FERTILIZER NITROGEN,
Science and Education Administration, Fort Collins, CO.
H. R. Duke, D. E. Smika, and D. F. Heermann.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 104, No. IR3, p 283-291, September, 1978. 6 fig, 2 tab, 8 ref.

Descriptors: Water pollution control, Nitrogen, Fertilizers, *Nitrates, Denitrification, *Groundwater, *Return flow, *Leachate, Sprinkler irrigation.

Excessive irrigation of the sandy soils to which center pivot sprinklers are adaptable can result in leaching of significant amounts of nitrogen fertilizer as NO3(-). Careful water management is an effective means of controlling NO3-N losses. The USDA irrigation scheduling program was used successfully to determine the timing and amount of irrigation necessary to maintain high crop yields yet minimize leaching losses. Although significant

NO3-N losses were measured from fields in the study area, neither the fraction of that NO3(-) present in return flows nor the mechanism of possible denitrification had been identified. It was expected that if, in fact, significant denitrification occurred in the vicinity of the water table as the data suggested, the potential for groundwater pollution by leached nitrates is considerably reduced. Even so, careful water management was considered to be an important factor in the irrigation program as it affects efficiency of fertilizer utilization, cost of energy for pumping, and ultimately the yield of crops produced. (Skogerboe-Colorado State)
W79-09494

A REVIEW OF THE ENVIRONMENTAL IMPACT OF GROUND DISPOSAL OF OIL SHALE WASTES,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5D.
W79-09572

5C. Effects Of Pollution

GREAT LAKES WATER QUALITY: SEVENTH ANNUAL REPORT TO THE INTERNATIONAL JOINT COMMISSION.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
Submitted to the International Joint Commission, Canada and United States, July 1979. 117 p, 6 fig, 15 tab. Final Report under the 1972 Agreement.

Descriptors: *Lake Erie, *Lake Huron, *Lake Michigan, *Lake Ontario, *Lake Superior, *Water quality, Eutrophication, Water pollution, Phosphorus compounds, Gulls, Polychlorinated terphenyls, Nitrates, Nitrites, Mercury, Mirex, Waste water(Pollution), Regulation, Trace elements, Toxicity.

The progress made by the United States and Canada to comply with the goals of the 1972 Great Lakes Water Quality Agreement is reported. Highlights of the report are: (1) forty-eight problem areas were identified where water quality objectives or standards were exceeded, one more than in 1977; (2) decreases in the concentration of DDT, DDE, dieldrin, HCB, mirex, and PCB's in herring gull eggs from Lakes Superior, Huron, Erie, and Ontario were reported; (3) PCBs in Lake Michigan coho salmon and bloater chubs continued to decline; (4) a previously undetected type of compounds, polychlorinated terphenyls, was found in herring gull eggs from Lake Erie; (5) trace levels of dioxin were reported in fish from Lake Ontario; and (6) total phosphorus concentrations showed a decline in Lake Michigan and Ontario. Whole lake water quality assessments are presented with major emphasis on eutrophication, the control of phosphorus loadings, and persistent contaminants. Progress made with regulatory and remedial programs to reduce the input of pollutants to the Great Lakes System is reported. A glossary of commonly used terms and abbreviations in the field of water quality is included. (Seigler-IPA)
W79-09417

GREAT LAKES WATER QUALITY: SEVENTH ANNUAL REPORT, APPENDIX B: ANNUAL REPORT OF THE SURVEILLANCE SUBCOMMITTEE,
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
Submitted to the Implementation Committee, Great Lakes Water Quality Board, July 1979. 125 p, 30 fig, 35 tab, 26 ref.

Descriptors: *Lake Erie, *Lake Huron, *Lake Michigan, *Lake Ontario, *Lake Superior, *Water quality, Eutrophication, Water pollution, Phosphorus compounds, Gulls, Polychlorinated terphenyls, Nitrates, Nitrites, Mercury, Mirex, Hydrocarbon, Runoff.

A lake-by-lake water quality assessment of the Great Lakes with particular emphasis on contaminants is reported. Included is a final status report of Lake Michigan from the intensive studies of 1976-1977, and a preliminary analysis of the water quality of Lake Erie from the intensive studies of 1978. Whole lake assessments cover eutrophication, contaminants, and special problem areas for each of the five lakes. Although only limited surveillance work was performed on Lake Superior, results show a decline in most harmful contaminant concentrations. Lake Huron showed a decrease of total phosphorus at three water intakes along the eastern shore. Total phosphorus levels also continued to decrease in Lake Ontario, but nitrogen levels continued to increase. A review of the state of the art of measuring atmospheric inputs, including acid rain, contaminants, and nutrients is presented to serve as a basis on which atmospheric surveillance and monitoring strategy can be developed. Planned 1979 surveillance activities are outlined for eack lake along with the performing agency and cost. A bibliography of United States and Canadian surveillance and monitoring related studies is also provided. (Seigler-IPA)
W79-09418

GREAT LAKES WATER QUALITY: SIXTH ANNUAL REPORT, APPENDIX B: ANNUAL REPORT OF THE SURVEILLANCE SUBCOMMITTEE.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
Submitted to the Implementation Committee, Great Lakes Water Quality Board, July 1978. 118 p, 25 fig, 33 tab, 14 ref, 3 append.

Descriptors: *Lake Erie, *Lake Huron, *Lake Michigan, *Lake Ontario, *Lake Superior, *Water quality, Eutrophication, Water pollution, Phosphorus compounds, Gulls, Polychlorinated terphenyls, Nitrates, Nitrites, St Lawrence River, Mercury, Mirex, Hydrocarbons, Runoff.

A lake-by-lake water quality assessment of the Great Lakes to provide a better understanding of the physical, chemical, and biological interactions that take place in these waters is reported. Eutrophication states, key contaminants, and special problem areas are identified for each of the five lakes. The lake assessments are designed such that the major issues of eutrophication and contamination are compared within and between lakes. Phosphorus loads are given for each lake with most of the lakes showing a decrease. Intensive analysis for persistent organic contaminants in herring gulls and their eggs revealed only one previously unreported class--polychlorinated terphenyls (PCTs). Findings from five studies conducted by the Data Quality Work Group are reported. A program description of planned 1979 Surveillance activities is included along with a bibliography of surveillance and monitoring studies. (Seigler-IPA)
W79-09419

GREAT LAKES SCIENCE ADVISORY BOARD, ANNUAL REPORT TO THE INTERNATIONAL JOINT COMMISSION, JULY 1979,
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Science Advisory Board.
July 1979. 117 p, 12 fig, 7 tab, 5 ref, 2 append.

Descriptors: *Great Lakes, *Water quality, *Environmental effects, *Eutrophication, *Toxicity, Water pollution, Sludge, Waste water treatment, Acidic water, Public health, Persistence, Phosphorus compounds, Detergents, Land use, Regional planning.

Four major areas are used to assess the Great Lakes Basin from an ecosystem approach. Acid precipitation is discussed to illustrate the broad implications of long-range transport of atmospheric pollutants. Topics reviewed that are pertinent to acid precipitation include: ecological effects, human health, import and export to and from the Basin, energy consumption, ameliorative and corrective measures, air pollution technology, regulatory options, and information needs. In the area of toxic substance control, a computer data base was developed to aid in forecasting those chemicals manufactured or used in the Basin with potential to persist and bioaccumulate with the ecosystem. Lists of hazardous and potentially hazardous polluting substances are provided in an appendix. Socio-economic futures for the Basin area are discussed in terms of future trends in: urban growth, land use (natural resources), local and regional planning, transportation, energy, investment and finance, and technological and social change. Environmental mapping is recommended as a tool which may aid future management efforts in the Great Lakes Basin. Eutrophication studies, the fourth major area, includes: phosphorus management strategies, health and ecological effects of detergent builders, sludge disposal research, bioavailability of phosphorus and the operation and maintenance of municipal waste water treatment plants. (Seigler-IPA)
W79-09463

GREAT LAKES WATER QUALITY: SEVENTH ANNUAL REPORT, APPENDIX G: ANNUAL REPORT OF THE COMMITTEE ON THE ASSESSMENT OF HUMAN HEALTH EFFECTS OF GREAT LAKES WATER QUALITY,
International Joint Commission-United States and Canada, Windsor (Ontario). Committee on the Assessment of Human Health Effects of Great Lakes Water Quality.
Presented to the Great Lakes Water Quality Board and to the Great Lakes Science Advisory Board, July 1979. 37 p, 2 fig, 1 tab, 57 ref.

Descriptors: *Great Lakes, *Water quality, *Water pollution, *Hazards, *Human pathology, *Toxicity, Public health, Lethal limit, Poisons, Environmental effects, Sludge, Wastes, Chemical interactions, Chemical degradation, Carcinogenicity, Mutagenicity.

A program to establish a running inventory of toxic chemicals used, manufactured, or imported into the Great Lakes Basin, and to evaluate their risk to human health and the environment is reviewed. Categories of criteria and a scoring system to classify the 400 chemicals identified in the Basin were developed. Categories are: acute toxicity, carcinogenicity, reproductive, heritable mutagenicity, neurobehavioral toxicity, and chronic adverse effects. Numerical scores are assigned under each category for the degree of hazard by oral, dermal, and aquatic dosages. Guidelines for determining estimates of human exposure to toxic compounds were also developed. Estimates of human exposure combined with data on toxicity provide a measurement of the public health concern for a given compound. The program also allows for the possibilities of chemical interactions, transformations, and degradation. (Seigler-IPA)
W79-09475

PROCEEDINGS OF THE SYMPOSIUM ON POTENTIAL HEALTH AND ENVIRONMENTAL EFFECTS OF SYNTHETIC FOSSIL FUEL TECHNOLOGIES, SEPTEMBER 25-28, 1978, OAK RIDGE, TENNESSEE.
CONF-780903. Oak Ridge National Laboratory, Oak Ridge, Tennessee, July 1979, 288 p.

Descriptors: *Environmental effects, *Energy production, *Fossil fuels, Public health, Conferences, Publications, Synthetic fossil fuel technology.

This was the first in a continuing series of Life Sciences Symposia of the Oak Ridge National Laboratory which consider broad topical areas of research and development of a multidisciplinary nature. Topics selected for the 1978 symposium were in response to national requirements of incorporating environmental- and health-protection goals in the implementation of energy programs. General subject areas included in the symposium were: technology and controls; chemical characterization in problem identification; biological effects studies; environmental transport and ecological effects; and occupational health control technology. Twenty nine papers were presented, and are included in the proceedings, which relate to current work and recent experimental findings related to the existing understanding of potential impacts and their reduction. (See W79-09542 thru W79-09547) (Chilton-ORNL)

W79-09541

POTENTIAL EMISSION, EFFLUENT, AND WASTE PROBLEMS IN COAL CONVERSION PROCESSES,
Pullman Kellogg, Houston, TX. Research and Development Center.
L. E. Bostwick.
In: Proceedings of the Symposium on Potential Health and Environmental Effects of Synthetic Fossil Fuel Technologies, September 25-28, 1978. CONF-780903. p 5-13, July 1979, 2 fig, 26 ref.

Descriptors: *Environmental effects, *Pollution, Standards, Fossil fuels, Energy conversion, Coals, Effluents, Solid wastes, Coal conversion technology, Emissions.

This paper presents an overview of the problems and descriptions of the proposed solutions which were developed in an EPA-funded study on the application of control technology to liquid effluents, gaseous emissions and solid wastes from coal conversion processes. It was concluded that liquid effluents can be treated for recycling within the processes and thus avoid discharge to receiving waters, that gaseous and particulate emissions can be controlled to meet present environmental standards, and that it is possible to manage the disposal of solid wastes. (See also W79-09541) (Chilton-ORNL)
W79-09542

NATIONAL PROGRESS IN CONTROL OF WASTEWATER FROM COAL CONVERSION PROCESSES,
Oak Ridge National Lab., TN.
J. A. Klein.
Proceedings of the Symposium on Potential Health and Environmental Effects of Synthetic Fossil Fuel Technologies, September 25-28, 1978, Oak Ridge, Tennessee, CONF-780903. p 15-21, July 1979. 4 fig, 3 tab, 12 ref. DOE W-7405-eng-26.

Descriptors: *Water pollution, *Environmental effects, Energy conversion, Fossil fuels, Coals, Oil shales, Effluents, Standards, Evaluation, Coal conversion technology.

An overview of national programs in the area of environmental control technology for coal conversion aqueous wastes is presented. Gasifiers now under development are capable of being operated under conditions in which they should produce little, if any, harmful pollutants but it is anticipated that most of the developing coal conversion processes will probably produce large quantities of effluents. The transfer of these effluents to streams will be of great concern since they will contain sizable amounts of known toxic and carcinogenic materials. A program to perform field evaluation studies is proposed. (See also W79-09541) (Chilton-ORNL)
W79-09543

EFFECTS OF COMPLEX EFFLUENTS FROM IN SITU FOSSIL FUEL PROCESSING ON AQUATIC BIOTA,
Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
H. L. Bergman, G. M. DeGraeve, A. D. Anderson, and D. S. Farrier.
In: Proceedings of the Symposium on Potential Health and Environmental Effects of Synthetic Fossil Fuel Technologies, September 25-28, 1978, Oak Ridge, Tennessee, CONF-780903. p 204-211, July 1979. 4 fig, 4 tab, 27 ref. ET-77-S-03-1761.

Descriptors: *Environmental effects, *Water pollution, *Fossil fuels, Effluents, Energy conversion, Rainbow trout, Daphnia, Mortality, Toxicity, Oil shales, Fathead minnows, Coal conversion technology, Coal gasification.

Acute and limited-chronic toxicity bioassays were conducted on process waters from Omega-9 retort water from the Rock Springs Site 9 in situ oil shale processing experiment and from Hanna-3 condenser water from the Hanna underground coal gasification experiment. Acute toxicity of tests of the retort water from Omega-9 oil shale experiment showed that the 96-h TL50 for rainbow trout and fathead minnows and the 48-h TL50 for Daphnia pulex were all at a retort water dilution of about 0.5%. In limited-chronic bioassays the threshold effect level for rainbow trout egg hatchability was at about 0.3% retort water and growth of rainbow trout fry was reduced at approximately 0.1% retort water. Acute toxicity bioassays with condenser water from Hanna-3 UCG experiment resulted in 96-h TL50 dilutions of about 0.1% for rainbow trout and fathead minnows and a 48-h TL50 of 0.2% for Daphnia pulex. Threshold level effects for fathead minnow egg hatchability and fry growth were about 0.04 and 0.02%, respectively. (See also W79-09541) (Chilton-ORNL)
W79-09546

RESPONSE OF AQUATIC BIOTA TO EFFLUENTS FROM THE FORT LEWIS, WASHINGTON, SOLVENT REFINED COAL PILOT PLANT,
Battelle Pacific Northwest Labs., Richland, WA.
J. B. States, C. D. Becker, M. J. Schneider, and J. A. Strand.
In: Proceedings of the Symposium on Potential Health and Environmental Effects of Synthetic Fossil Fuel Technologies, September 25-28, 1978, Oak Ridge, Tennessee, CONF-780903. p 212-220, July 1979. 7 fig, 1 tab, 1 ref. DOE EY-76-C-06-1830.

Descriptors: *Environmental effects, *Water pollution, Aquatic life, Toxicity, Fossil fuels, Coals, Energy conversion, Effluents, Washington, Fort Lewis, Solvent Refined Coal, Coal conversion.

Samples of waste effluent from the Solvent Refined Coal pilot plant (SRC) were used to perform toxicity tests using mostly fish as test organisms. Results of the tests indicated that untreated liquid effluents originating within the plant contain features that make it highly toxic to aquatic life. Treated process effluent passing through the biodigester, sand filter, and activated charcoal filter is relatively low in toxicity to aquatic life. Screening of all potentially damaging source materials for acute and chronic effects at several levels of biological organization is suggested before turning to detailed chemical and biological investigations into exact causes of some of the more serious effects revealed by the present study. (See also W79-09541) (Chilton-ORNL)
W79-09547

ANALYSIS OF POPULATIONS OF BORING AND FOULING ORGANISMS IN THE VICINITY OF OYSTER CREEK NUCLEAR GENERATING STATION, ANNUAL PROGRESS REPORT, SEPTEMBER 1, 1977-AUGUST 31, 1978,
Lehigh Univ., Stone Harbor, NJ. Wetlands Inst.
K. E. Hoagland, and L. Crocket.
Report NUREG/CR-0634. March 1979. 114 p, 18 fig, 29 tab, 21 ref, 4 append. AT(49-24)-0347.

Descriptors: *Environmental effects, *Water pollution, Powerplants, Nuclear powerplants, Invertebrates, Aquatic life, Fouling, Oyster Creek, New Jersey, Discharge(Water), Fouling organisms, Borers, Shipworms.

The purpose of this investigation was to observe levels of shipworm infestation in areas adjacent to Oyster Creek Nuclear Generating Station, particularly in water intake and discharge systems. In addition, species composition, breeding, and settlement of all boring and fouling invertebrates that associate themselves with wooden test panels at 18 stations were observed. Data for the period May 1977-August 1978 is interpreted in context of results of observations made since 1971. In early spring of 1978, a shipworm outbreak occurred which was dominated by Teredo bartschi. A few T. navalis, B. gouldi, and T. furcifera were also found. The finding of one T. bartschi at Forked River Beach indicated that the species can be carried by recirculated waters. Dominant species of fouling organisms were found to change on a monthly basis but to repeat on a seasonal basis. Some competitive interaction between shipworms, Limnoria, and other organisms occupying wood substrates is indicated. (Chilton-ORNL)
W79-09548

RESPONSES OF SELECTED CHESAPEAKE BAY FISH AND INVERTEBRATE SPECIES TO NATURAL AND ARTIFICIAL THERMAL INCREASES - A REVIEW OF THE LITERATURE,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
L. H. Liden, and D. T. Burton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-290 596, Price codes: A03 in paper copy, A01 in microfiche. 1978. 58 p, 9 fig, 112 ref.

Descriptors: *Environmental effects, *Water pollution, *Thermal pollution, Nuclear powerplants, Temperature, Fish, Populations, Chesapeake Bay.

Data from biological literature were evaluated to ascertain what effects, if any, the thermal discharge from Calvert Cliffs Nuclear Power Plant would have upon populations of Pseudopleuronectes americanus, Morone saxatilis, Leiostomus xanthurus, Midropogon undulatus, Menidia menidia, Anchoa mitchelli, Brevoortia tyrannus and Crassotrea virginica and Callinectes sapidus living in Chesapeake Bay. It was concluded that the thermal discharge from the power plant had a maximum temperature increase of 5.6 C above ambient and that this would have little or no impact on the egg, larval, juvenile or adult populations of the studied species. (Chilton-ORNL)
W79-09549

ECOLOGICAL EFFECTS OF COAL-FIRED STEAM-ELECTRIC GENERATING STATIONS,
Environmental Research Lab.-Duluth, MN.
G. E. Glass.
In: Energy/Environment III. EPA Decision Series, Report EPA-600/9-78-022, October 1978. p 121-149, 19 fig, 7 tab, 34 ref.

Descriptors: *Environmental effects, *Powerplants, Electric power production, Fossil fuels, Mining, Transportation, Storage, Combustion.

The purpose of the program reported in this paper is to determine the ecological impact of increased fossil-fuel utilization. The program is in the third year of a 5-year plan. Projects were funded in the three major areas of mining, transportation and storage, and combustion of coal. This comprehensive report attempts to integrate and generalize the findings in these areas. (Chilton-ORNL)
W79-09550

WATER-RELATED ENVIRONMENTAL EFFECTS IN FUEL CONVERSION: VOLUME I. SUMMARY,
Water Purification Associates, Cambridge, MA.
H. Gold, and D. J. Goldstein.
Report EPA-600/7-78-197a. October 1978. 231 p, 52 fig, 69 tab, 74 ref. 68-03-2207.

Descriptors: *Environmental effects, *Water pollution, Cooling water, Water requirements, Fuels, Fossil fuels, Energy, Costs, Coal conversion technology.

In this examination of water-related effects to be expected from siting conversion plants in major coal and oil shale bearing regions of the U.S., 90 plant site combinations were studied (48 in Central and Eastern U.S. and 42 in Western). Several fuel technologies are examined. The results of this study include the range of water requirements, conditions for narrowing the range and bringing about optimum use of water, ranges of residual solid wastes, and cost and energy requirements for waste-water treatment. Emphasis is placed on the need for site and design specific studies. It is suggested that the amount of wet cooling be related to the cost of water in the specific area. All water requirements studied in this report are based on complete water re-use. (Chilton-ORNL)
W79-09551

Group 5C—Effects Of Pollution

FISH PROTECTION AT STEAM-ELECTRIC POWER PLANTS: ALTERNATIVE SCREENING DEVICES,
Oak Ridge National Lab., TN.
J. B. Cannon, G. F. Cada, K. K. Campbell, D. W. Lee, and A. T. Szluha.
Report ORNL/TM-6472, July 1979. 142 p, 67 fig, 19 tab, 135 ref. W-7405-eng-26.

Descriptors: *Environmental effects, *Entrainment, Powerplants, Cooling water, Aquatic life, Mortality, Impingement, Alternative devices.

This study examines engineering feasibility, biological effectiveness and costs of alternative screening devices to be utilized for fish protection at power plant cooling-water intakes. Physical screening barriers which are considered include: conventional vertical traveling screens (VTS) with modifications, center-flow traveling screens, flush-mounted horizontal traveling screens (HTS), cylindrical wedge-wire screens, and radial well intakes. Behavioral screening devices considered are the angled HTS and louver and angled screen diversion systems. Radial well intakes and cylindrical wedge-wire screens function as exclusion devices. Exclusion devices conceptually provide the most effective means of minimizing impingement and entrainment mortality. The extent to which physical screening devices can reduce impingement and entrainment mortality is site and species specific. It was concluded that alternative devices are available to potentially reduce impingement and entrainment but that these are site specific. (Chilton-ORNL)
W79-09552

THE EFFECT OF TEMPERATURE ON THE TOXICITY OF CHLORINATED COOLING WATERS TO MARINE ANIMALS - A PRELIMINARY REVIEW,
Woods Hole Oceanographic Institution, MA.
J. M. Capuzzo.
Marine Pollution Bulletin, Vol. 10, No. 2, p 45-47, February 1979. 1 tab, 14 ref. ERDA E(11-1)-2532.

Descriptors: *Environmental effects, *Temperature, *Chlorine, Marine organisms, Toxicity, Absorption, Synergism.

This report is a preliminary review of the problem of temperature-chlorine toxicity based on data obtained from this study and from other published reports. Several marine organisms were exposed to toxicant added as free chlorine or chloramine for periods of 30 to 60 minutes. Except for the copepod, Acartia tonsa, temperature was found to have a synergistic effect on the toxicity of both halogen forms. It was suggested that this synergistic effect was due to an interaction of uptake rates and regulation of physiological rates. Greatest enhancement in sensitivity should be expected at the upper limit of a species' thermal tolerance. (Chilton-ORNL)
W79-09553

BIOACCUMULATION AND BIOAMPLIFICATION OF MERCURY COMPOUNDS IN A SECOND LEVEL CONSUMER, GAMBUSIA AFFINIS - TEMPERATURE EFFECTS,
Bordeaux I Univ., Talence (Italy). Lab. d'Ecologie Animale.
A. Boudou, A. Delarche, F. Ribeyre, and R. Marty.
Bulletin of Environmental Contamination and Toxicology, Vol. 22, No. 6, p 813-818, 1979. 4 fig, 6 ref.

Descriptors: *Environmental effects, *Toxicity, Fish, Mercury, Absorption, Freshwater, Mortality, Food chains, Temperature, Direct contamination, Bioamplification.

Bioaccumulation was studied over a period of 30 days, starting with a quantity of 1 microg of methyl-mercury/l of water (1 ppb) at three temperatures (10, 18, and 26 C). The experimental trophic chain was Producer-Chlorella vulgaris, First level consumer-Daphnia magna, First level carnivorous-Gambusia affinis. Direct contamination studies were also carried out. Results indicated that methyl mercury is far more toxic than HgCl2 and that mortality increases as the water temperature rises. With a quantity of 1 ppb in the environment, the Gambusia affinis yields a concentration of toxicant mass of 27000 after 30 days contamination at 26 C. Studies of bioaccumulation by direct contamination (1 ppb in water) shows no proportional relation of the process to the time factor. A leveling off was pronounced at 18C. (Chilton-ORNL)
W79-09554

GROWTH RATES AND SIZE DISTRIBUTIONS OF FIRST-YEAR SMALLMOUTH BASS POPULATIONS: SOME CONCLUSIONS FROM EXPERIMENTS AND A MODEL,
Oak Ridge National Lab., TN.
D. L. DeAngelis, and C. C. Coutant.
Transactions of the American Fisheries Society, Vol. 108, No. 2, p 137-141, 1979. 3 fig, 23 ref.

Descriptors: *Model studies, Mathematical models, Fish, Bass, Growth rates, Temperature, Time, Size, Laboratory tests, Fry.

Techniques of mathematical modeling are applied to experiments on the growth rates of first-year smallmouth bass under laboratory conditions. Swim-up fry were studied for 2-3 weeks with groups being kept at constant temperatures ranging from 15.2 to 32.5C. Average length of fish in each group increased linearly with time (t) in a range from 10 to 30 mm. Variance about these mean lengths increased approximately as t square. The model shows that the observed length-vs-time phenoma are expected if the rates of increase of length of fish are independent of length and that rates for individuals are normally distributed about some mean rate of growth. Agreement between experiment and theory shown in this model suggests that there is some degree of determinism in the dynamics of size distribution. (Chilton-ORNL)
W79-09555

MEASUREMENTS OF THE EFFECT OF HEATING ON SURVIVAL AND GROWTH OF NATURAL PLANKTON POPULATIONS,
KEMA N.V., Arnhem (Netherlands).
M. Donze.
Verh. Internat. Verein. Limnol., Vol. 20, p 1822-1826, November 1978. 3 fig, 2 ref.

Descriptors: *Environmental effects, *Water pollution, *Thermal stress, Plankton, Populations, Temperature, Growth rate, Mortality.

Natural plankton populations were incubated in floating tanks, one of which was kept at elevated temperature. Phytoplankton species mostly retained a constant population independent of temperature shock and persistent temperature increase. Only a few species showed growth or decline of more than a factor of 2 in 10 days. Zooplankton populations generally increased and it was suggested that this might be due to the absence of predation, to the tanks being a more favorable environment than the river, or to the fact that they are given time to increase. Increased grazing did not take place. Increased temperature increased the growth rate of rotifers. Species of Brachionus died off after initial growth at higher temperatures due to infection. Copepod populations showed no damage after application of temperature shocks. Significant mortality was found in Cladocerans. After temperature shock of 13.5C, Bosmina and Daphnia showed initial decline with recovery in 5 days. (Chilton-ORNL)
W79-09556

STUDIES OF THE EFFECT OF COPPER, ZINC AND IRON ON THE BIOTIC COMPONENTS OF AQUATIC ECOSYSTEMS,
Technical Univ. of Warsaw (Poland). Inst. of Environmental Engineering.
M. Furmanska.
Polskie Archiwum Hydrobiologii, Vol. 26, No. 1/2, p 213-220, 1979. 2 tab, 7 ref.

Descriptors: *Environmental effects, *Water pollution, *Toxicity, Copper, Zinc, Iron, Aquatic life, Crustaceans, Fish, Snails, Plants.

Acute (48 hr) tests showed a decreasing order of toxicity for the metals used in these experiments to be copper, zinc, and iron. Crustaceans were the most sensitive animals with fish and snails being more resistant. In chronic tests (19 days) it was found that bottom sediment microorganisms which responded to traces of the investigated elements by a decrease in respiratory activity were most sensitive. Higher animals showing mortality at Cu, Zn, and Fe concentrations of 3.75, 6.25, and 7.5 mg/cubic dm, respectively, were less sensitive than bottom animals. Elodea canadensis was somewhat less sensitive, displaying leaf cellular structure deformation at concentrations of 51, 25, and 30 mg/cubic dm of Cu, Zn, and Fe, respectively. Psychrophilic bacteria were most resistant. Comparison of chronic and acute test showed that cumulative toxicity of copper, zinc and iron was nine times higher under conditions of the chronic test. (Chilton-ORNL)
W79-09557

CHLORINE IN THE MARINE ENVIRONMENT,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
J. C. Goldman.
Oceanus, Vol. 22, No. 2, p 36-43, 1979. 5 fig, 7 ref.

Descriptors: *Environmental effects, *Chlorination, *Water pollution, Marine environment, Water quality, Water chemistry, Public health.

This paper reviews the historical uses of chlorine in water purification, wastewater treatment and in anti-fouling of power plant cooling waters. The beneficial aspects of chlorination as well as recent widespread public concern over the presence of carcinogens in drinking water are discussed. The chemistry of chlorine in the marine environment and the hazardous effects upon marine biota are described. Hope is expressed for solutions to the many problems presented. (Chilton-ORNL)
W79-09558

MORTALITY OF YOUNG FISH IN THE COOLING WATER SYSTEM OF BERGUM POWER STATION,
KEMA N.V., Arnhem (Netherlands).
R. H. Hadderingh.
Verh. Internat. Verein. Limnol., Vol. 20, p 1827-1832, November 1978. 1 fig, 5 tab, 4 ref.

Descriptors: *Environmental effects, *Entrainment, Powerplants, Fish, Mortality, Cooling water, Discharge(Water), Impingement.

These investigations showed that large numbers of organisms (up to 10 million/24 hours in May) are drawn into the cooling system of the Bergum power station. Smelt, pike-perch, and perch were the most abundant species. Entrainment mortality for smelt was 75% and impingement mortality was 95%. Percidae showed entrainment mortalities of 34% and impingement mortalities of 65%. It is suggested that mortality due to entrainment and impingement can be reduced by decreasing the amount of cooling water used. Investigations of diversion devices is planned. (Chilton-ORNL)
W79-09559

SOME PROBLEMS IN FINDING GOOD STANDARDS FOR COOLING WATER,
KEMA N.V., Arnhem (Netherlands).
F. B. J. Koops.
Verh. Internat. Verein. Limnol., Vol. 20, p 1833-1836, November 1978, 4 ref.

Descriptors: *Environmental effects, *Thermal pollution, Temperature, Cooling water, Fish, Mortality, Discharge(Water).

Ways in which a certain quantity of waste heat can be discharged into surface water with the least possible effect on ecology is discussed. Increase in cooling water quantities to lower presently used discharge temperature showed negative rather than positive effects, especially on young fish. Decrease in cooling water quantity reduced damage to young fish without causing serious damage to

other organisms. Even at discharge temperatures in excess of 30C damage to young fish can be reduced by keeping the temperature jump of the cooling water as high as possible and consequently the quantity of cooling water as small as possible, taking due care that the maximum permissible discharge temperature is not exceeded. (Chilton-ORNL)
W79-09560

BEHAVIOURAL RESPONSES OF SOME MARINE BIVALVES TO HEIGHTENED SEAWATER COPPER CONCENTRATIONS,
Natural Environment Research Council, Bangor (Wales). Marine Invertebrate Zoology Unit.
A. R. Manley, and J. Davenport.
Bulletin of Environmental Contamination and Toxicology, Vol. 22, No. 6, p 739-744, 1979, 6 fig, 1 tab, 17 ref.

Descriptors: *Environmental effects, *Toxicity, *Water pollution, Copper, Mollusks, Animal behavior.

Specimens of Modiolus modiolus, Chlamys opercularis, Crassostrea giga, and Modiolus demissus were maintained at 12-15C. Specimens of the tropical Anadara-senilis were maintained at 25C. Animals were exposed to an increasing concentration of copper by introducing a constant flow of pollutant into their tanks. M. edulis, C. gigas, M. demissus, A. senilis and M. modiolus showed an initial shell valve adduction followed by testing behavior. Concentrations of total copper in seawater at which normal behavior was interrupted were: M. modiolus, 0.141 ppm; M. edulis, 0.021 ppm; C. gigas, 0.085 ppm; A. senilis, 0.120 ppm; and M. demissus, 0.05 ppm. The response of C. opercularis to increasing copper concentration was shown by an increase in the frequency of shell movement and it is suggested that this might represent an attempt at swimming but the animals were fixed in position. It was concluded that concentrations of total copper of the magnitude required to result in total valve closure are not normally encountered in the marine environment. (Chilton-ORNL)
W79-09561

OVERWINTER MORTALITY OF FINGERLING SMALLMOUTH BASS IN RELATION TO SIZE, RELATIVE ENERGY STORES, AND ENVIRONMENTAL TEMPERATURE,
Toronto Univ. (Ontario). Dept. of Zoology.
J. D. Oliver, G. F. Holeton, and K. E. Chua.
Transactions of the American Fisheries Society, Vol. 108, No. 2, p 130-136, 1979. 4 fig, 2 tab, 18 ref.

Descriptors: *Environmental effects, *Thermal stress, Bass, Winterkilling, Temperature, Size, Mortality.

Smallmouth bass of 0+ age and 55-107 mm total length were overwintered at temperatures simulating those of the natural environment. Final temperatures were 2, 4, and 6C. Final temperature did not influence mortality rates. Longer fish survived better than short ones. It was found that during wintering body ratios of dry weight/wet weight, lipid weight/dry weight, and ignitable weight/dry weight all decreased. It was suggested that there may be critical percentages of dry weight/wet weight and ignitable weight/dry weight below which fingerling smallmouth bass will die. (Chilton-ORNL)
W79-09562

INFLUENCE OF TEMPERATURE-SALINITY COMBINATIONS ON THE FOOD INTAKE, GROWTH AND CONVERSION EFFICIENCY OF GAMBUSIA AFFINIS (PISCES),
Bangalore Univ. (India). Dept. of Zoology.
K. Shakuntala, and R. Reddy.
Polskie Archiwum Hydrobiologii, Vol. 26, No. 1/4, p 173-181, 1979. 1 fig, 6 tab, 34 ref.

Descriptors: *Environmental effects, *Thermal pollution, Temperature, Fish, Growth rates, Foods, Energy budget, Salinity, Food intake, Conversion efficiency.

Gambusia affinis were reared from day 1 to 50 days of age under temperature-salinity combinations of 20, 25, and 30 C and 0, 1, 3, 5, and 7‰ S. Higher temperature resulted in higher salinity preference where the fish showed maximum survival, daily food consumption and growth. At any one salinity level, maximum growth was shown at 25C. On the whole, maximum conversion efficiency was found at 20C (11.0 to 25.5%). (Chilton-ORNL)
W79-09563

HEAT AND COLD TOLERANCE OF THE PLANARIAN, DUGESIA JAPONICA, IN RELATION TO ACCLIMATION TEMPERATURE,
Osaka City Univ. (Japan). Dept. of Biology.
H. Tsukuda, K. Ogoshi, and T. Daikoku.
Annotationes Zoologicae Japonenses, Vol. 51, No. 2, p 70-78, 1978, 5 fig, 18 ref.

Descriptors: *Environmental effects, *Thermal stress, Resistance, Temperature, Aquatic life, Invertebrates, Planaria.

Planarians from stock culture were acclimated to 13, 18, and 23C for more than 6 months before temperature tolerance tests were conducted. Tolerance was tested on anterior and posterior as well as on whole intact animals. Tolerance of intact animals increased distinctly with acclimation temperature. All 23 C-acclimated animals survived 40 min exposure to 35C while 13C acclimated animals were subject to lethal effect in 20 min at 33C. Anterior and posterior halves were found to be more heat tolerant than intact animals and the difference between 13 and 18C acclimation was smaller. Histological examination showed that upon exposure to heat the epidermis is injured gradually from the head toward tail. (Chilton-ORNL)
W79-09564

TEMPERATURE EFFECT ON THE CONCENTRATION OF RADIONUCLIDES BY MARINE ORGANISMS,
National Inst. of Radiological Sciences, Nakaminato (Japan). Marine Radio-Ecological Research Station.
M. Nakahara, T. Koyanagi, and M. Saiki.
Journal of Radiation Research, Vol. 18, p 122-131, 1977, 4 fig, 3 tab, 16 ref.

Descriptors: *Environmental effects, *Thermal stress, *Radioisotopes, Marine organisms, Fish, Clams, Cobalt, Cesium, Zinc, Temperature, Sea water.

Several species of marine organisms were exposed to radionuclides at varying seawater temperatures. Exposure of mackerel (Scomber japonicus) to Zn 65 resulted in concentration factors increasing 1.5 to 2.5 times and release of Zn 65 being increased from 10 to 70% at temperatures of 12 to 22C. Concentration of Cs 137 by blackfish (Girella punctata) in the temperature range of 15 to 35C was most pronounced at 20 to 25C. Concentration of Co 60 by crimson sea breams (Erynnis japonica) was highest in scale and gill tissue. Accumulation of Co 60 in midgut tissue of clams (Meretrix lamarkii) was also affected by temperature. (Chilton-ORNL)
W79-09565

DIFFERENTIATION IN RESPONSE TO CHILLING TEMPERATURES AMONG POPULATIONS OF THREE MARINE SPERMATOPHYTES, THALASSIA, TESTUDINUM, SYRINGODIUM FILIFORME AND HALODULE WRIGHTTI,
Texas Univ. at Austin. Plant Ecology Research Lab.
C. McMillan.
American Journal of Botany, Vol. 66, No. 7, p 810-819, August 1979, 9 tab, 16 ref.

Descriptors: *Environmental effects, *Aquatic plants, Cold resistance, Temperature, Resistance, Populations, Gulf of Mexico, Caribbean, Genetics.

Three species of seagrasses from the Gulf of Mexico-Caribbean were subjected to chilling temperatures. Response of populations from the southern portions of the Gulf and Caribbean showed the greatest chill damage while those populations from the northern gulf showed least injury. Decreasing order of chill tolerance in three species was Halodule, Thalassia Syringodium. C14 uptake by leaves following chill exposure showed quantitative differences correlating with the amount of leaf damage in the various populations. Data suggested an inherently different percentage of fatty acid saturation in temperate and tropical populations. No significant change in saturation of fatty acid occurred upon chilling in Texas plants. It was concluded that differentiation of response to chilling among the seagrass populations is based on inherited properties. (Chilton-ORNL)
W79-09566

RESPIRATORY RESPONSES OF LARGEMOUTH BASS (MICROPTERUS SALMOIDES) TO ENVIRONMENTAL CHANGES IN TEMPERATURE AND DISSOLVED OXYGEN,
California Univ., Davis. Div. of Wildlife and Fisheries Biology.
J. J. Cech, Jr., C. G. Campagna, and S. J. Mitchell.
Transactions of the American Fisheries Society, Vol. 108, No. 2, p 166-171, 1979, 2 fig, 2 tab, 15 ref.

Descriptors: *Environmental effects, *Thermal stress, Temperature, Dissolved oxygen, Drought tolerance, Droughts, Bass, Mortality.

Respiratory metabolism of largemouth bass under conditions of high temperature and low dissolved oxygen such as characterize drought environments was measured. Critical oxygen tensions were found to increase from <40 torr P02 at 20C, to 40-50 torr at 25C, to 50-60 torr at 30C. Increased anaerobic metabolism associated with an oxidative metabolic depression was indicated at high temperatures and low dissolved oxygen concentrations. It was concluded that maintenance of 2.60 mg 02/1 at 25C and 2.85 mg 02/1 at 30C in largemouth bass habitats would reduce adult mortalities which are associated with insufficient oxygen. (Chilton-ORNL)
W79-09567

EFFECTS OF CADMIUM ON THE INTRACELLULAR POOL OF FREE AMINO ACIDS IN MYTILUS EDULIS,
Northeastern Univ., Boston, MA. Dept. of Biology.
L. B. R. Briggs.
Bulletin of Environmental Contamination and Toxicology, Vol. 22, No. 6, p 838-845, 1979, 1 fig, 4 tab, 16 ref.

Descriptors: *Environmental effects, *Water pollution, Metals, Cadmium, Mussels, Amino acids, Salinity, Toxicity.

Groups of mussels were kept at salinities of 30, 11, and 6‰ and exposed to additional cadmium concentrations of 0, 0.1, 1.0, and 5.0 ppm. After 208 hours exposure, cadmium had a significant effect upon alanine, glycine, and the total FAA osmolarity. There were no statistically significant cadmium-salinity interaction effects at this time. Mussels in 11 and 6‰ salinity did not open their valves for extended periods of time. These results indicate that saturation of the detoxification system in M. edulis occurs at about 1 ppm cadmium in 30‰ S water. (Chilton-ORNL)
W79-09568

THE EFFECT OF PHYSICAL FACTORS ON THE COLONIZATION AND RELOCATION BEHAVIOR OF IMMATURE BLACK FLIES (DIPTERA: SIMULIIDAE),
Michigan State Univ., East Lansing. Dept. of Entomology.
E. F. Gersabeck, Jr., and R. W. Merritt.
Environmental Entomology, Vol. 8, No. 1, p 34-39, February 1979, 2 fig, 2 tab, 30 ref.

Descriptors: *Environmental effects, *Animal behavior, Larvae, Diptera, Insect behavior, Flow, Temperature, Light, Depth, Black fly larvae, Substrate, Colonization.

Laboratory and field studies were used in this investigation on the influence of water velocity, substrate depth, substrate type, temperature, amount of light and stream characteristics on colonization and relocation behavior of black fly larvae. Results showed that water velocity, substrate placement and exposure time influenced substrate type selection in the field. Prosimulium mixtum/fuscum attached to either white tiles or clear plastic tapes but Cnephia dacotensis preferred white ceramic tiles. Both species showed a preference for specific velocity ranges. Neither species increased their relocation behavior when exposed to depths varying from 2 to 30 cm or to temperatures of 2 to 30 C. In the absence of light, P. mixtum/fuscum increased relocation behavior. (Chilton-ORNL)
W79-09569

TEMPERATURE SENSITIVITY: A CELL CHARACTER DETERMINED BY OBLIGATE ENDOSYMBIONTS IN AMOEBAS,
Tennessee Univ., Knoxville. Dept. of Zoology.
K. W. Jeon, and T. I. Ahn.
Science Vol. 202, p 635-637, November 1978, 2 fig, 1 tab, 12 ref.

Descriptors: *Environmental effects, *Temperature, Protozoa, Bacteria, Mortality, Symbiosis.

A strain of Amoeba proteus has been developed which is dependent on endosymbiotic bacteria that are psychrophile-like. It was found that these symbiotic amoebas are unable to survive at temperatures above 26C. At 26C, the symbiotic amoebas died out within 2 weeks after having divided more than four times. All the symbionts disappeared from the amoebas by the 7th day of culture at 26C while nonsymbiotic amoebas continued to multiply. (Chilton-ORNL)
W79-09570

LIFE HISTORY OF A MULTIVOLTINE MAYFLY, TRICORYTHODES MINUTUS: AN EXAMPLE OF THE EFFECT OF TEMPERATURE ON THE LIFE CYCLE,
Stearns-Roger, Inc., Denver, CO. Environmental Sciences Div.
R. L. Newell, and G. W. Minshall.
Annals of the Entomological Society of America, Vol. 71, No. 6, p 876-881, November 1978, 11 fig, 1 tab, 24 ref.

Descriptors: *Environmental effects, *Temperature, Life history studies, Mayflies.

Life history of the mayfly Tricorythodes minutus was studied at 2 locations, one of which had a spring source and a relatively constant temperature of 18C and the other of which had a normal seasonal fluctuation in water temperature. Life cycle was unquestionably influenced by temperature with populations at the constant temperature station showing a multivoltine cycle and populations at the other station having a bivoltine cycle. Standing crop was variable, with maxima of 11,250/sq meter at the constant temperature station and 1400/sq meter at the other. At the second station, T. minutus behaves like a tropical insect and has apparently lost some of the accurate controls that a mayfly population normally requires to survive (timing of emergence, etc.). (Chilton-ORNL)
W79-09571

TOWARDS A REALISTIC PREDATOR-PREY MODEL: THE EFFECT OF TEMPERATURE ON THE FUNCTIONAL RESPONSE AND LIFE HISTORY OF LARVAE OF THE DAMSELFLY, ISCHNURA ELEGANS,
York Univ. (England). Dept. of Biology.
D. J. Thompson.
Journal of Animal Ecology, Vol. 47, p 757-767, 1978. 9 fig, 23 ref.

Descriptors: *Environmental effects, *Temperature, *Predation, Insects, Insect behavior, Feeding, Life history studies.

The specific aims of this work were to describe the effect of temperature on the functional response of a common polyphagous aquatic predator, namely penultimate instar larvae of the damselfly Ischnura elegans feeding upon a particular size-class of Daphnia magna and to relate the findings to the life history of Ischnura in the field and to the environmental temperature throughout the year. The attack coefficient was found to increase in a sigmoid manner with temperature while the handling time (time spent: pursuing, subduing, eating, digesting prey) declines logarithmically from 5 to 16C. Field temperature measurements show that onset and termination of growth revolve around a temperature of 8C which corresponds to the temperature in the laboratory experiments at which the attack coefficient begins to increase. (Chilton-ORNL)
W79-09574

A COMPARATIVE ANALYSIS OF THE ACTION OF CONSTANT TEMPERATURES ON THE EMBRYONIC DEVELOPMENT OF FOUR SPECIES OF STURGEONS,
Akademiya Nauk SSSR, Moscow. Inst. of Evolutionary Morphology and Animal Ecology.
N. G. Nikol'skaya, and L. A. Sytina.
Journal of Ichthyology, Vol. 18, No. 1, p 86-100, 1978. 3 fig, 3 tab, 37 ref.

Descriptors: *Environmental effects, *Temperature, Fish, Embryonic growth stage, Mortality, Sturgeon.

Development of four species of sturgeon (beluga sturgeon, sheap sturgeon, sturgeon, and sevryuga) were studied at lethal, sublethal, suboptimal, and optimal temperatures. At low sublethal temperatures, beluga eggs perished in the initial stages of division while in other species elimination occurred at later stages. High sublethal temperatures sharply curtailled the life span of beluga and sturgeon eggs. In sheap sturgeon, under the effect of high sublethal temperatures in their entire range, the development of individual, most resistant embryos, continued up to gastrulation. Sublethal temperatures had a double effect on sevryuga. Temperatures approaching lethal (29-30C) suppressed division in its initial stages, others (26-28C) caused the embryos to perish in later stages. With both low and high sublethal temperatures, a considerable period of retardation of development may precede death of the embryos. (Chilton-ORNL)
W79-09575

LABORATORY MEASUREMENTS OF DIGESTION RATE IN 0-GROUP FLOUNDER (PLATICHTHYS FLESUS L.) AT TWO TEMPERATURES,
Copenhagen Univ., Helsingoer (Denmark). Marine Biological Lab.
T. Kiorboe.
Ophelia, Vol. 17, No. 1, p 155-161, July 1978. 2 fig, 12 ref.

Descriptors: *Environmental effects, *Temperature, Model studies, Fish, Feeding, Digestion rate, Flounder.

The principle in the method used in this investigation was to measure the decrease in stomach content as the increase in amount of food needed to refill the stomach. The digestion rate was found to be higher at 15 than at 10C. At 10C the estimate of the rate-constant = 0.14/hour and 15C the rate-constant = 0.21/hour, which means that 13, respectively, 19% of the stomach content is digested every hour. This constitutes a statistically significant difference. (Chilton-ORNL)
W79-09576

SEASONAL LEVELS OF CHLORINATED HYDROCARBONS AND HEAVY METALS IN FISH AND BROWN SHRIMPS FROM THE MEDWAY ESTUARY, KENT,
City of London Polytechnic (England). Dept. of Biological Sciences.
W. L. F. van den Broek.
Environmental Pollution. Vol. 19, No. 1, p 21-38, 1979. 1 fig, 2 tab, 33 ref, 2 append.

Descriptors: *Environmental effects, *Water pollution, Heavy metals, Organic compounds, Fish, Shrimps, Medway estuary, England, Estuaries, Absorption, Bioaccumulation.

Sewage emptying into the Medway estuary is treated but with no facility for removing chlorinated hydrocarbons and heavy metals. This study was undertaken for the purpose of determining base line levels of these pollutants in selected species. Metal concentrations were low and indicated concentrations little more than background levels. Hydrocarbons were higher and showed no marked seasonal variations. (Chilton-ORNL)
W79-09577

SAFE ZINC AND COPPER LEVELS FROM THE SPRING CREEK DRAINAGE FOR STEELHEAD TROUT IN THE UPPER SACRAMENTO RIVER, CALIFORNIA,
California State Dept. of Fish and Game, Rancho Cordova. Water Pollution Control Lab.
B. J. Finlayson, and S. H. Ashuckian.
California Fish and Game, Vol. 65, No. 2, p 80-99, 1979. 2 fig, 6 tab, 27 ref, 4 append.

Descriptors: *Environmental effects, *Water pollution, Metals, Toxicity, Fish, Trout, Mine acids, Copper, Zinc, Mortality.

Sixty day and 96-hr bioassays were conducted on steelhead trout eggs, alevins, and swim-up fry using acid mine waste to determine the necessary dilution factors for safe copper-to-zinc ratios. Eggs were found to more resistant to solutions containing both metals than alevins or fry but solutions of zinc only affected all stages equally. At copper-to-zinc waste ratios of 1:12, copper was absent in solution at partially toxic levels. At copper-to-zinc waste ratios of 1:4, copper was present in sufficient quantities to increase toxicity. Incipient lethal levels in the stages from eggs to fry were .12 mg/l Zn at the 1:12 ratio and .10 mg/1 Zn and .011 mg/1 Cu at the 1:4 ratio. Incipient lethal level of controls was .03 mg/1 Zn. The presence of aluminum and iron did not appear to affect the toxicity of copper and zinc in the waste. (Chilton-ORNL)
W79-09578

SURVIVAL AND DEVELOPMENT OF ATLANTIC SALMON EGGS AND FRY AT THREE DIFFERENT TEMPERATURES,
Norges Landbrukshoegskole, Vollebekk. Dept. of Animal Genetics and Breeding.
K. Gunnes.
Aquaculture, Vol. 16, No. 3, p 211-218, 1979. 7 fig, 2 tab, 12 ref.

Descriptors: *Environmental effects, *Temperature, Thermal stress, Salmon, Growth stages, Embryonic growth stage, Hatching, Fry.

Groups of Atlantic salmon eggs were incubated at temperatures of 8, 10, and 12 C. At 12 C, mortality was high, fry averaged little more than half the weight of those hatched at the two lower temperatures and development of alevins to swim-up fry was abnormal. Results indicated that the optimum temperature from hatching to swim-up varies according to the temperature experienced during egg incubation. At incubation of 10 C, it was advantageous to reduce the temperature to 8 C for the following period. During the first 6 weeks of feeding, mortality rate was correlated with mortality during earlier development. Total numbers of day-degrees required by eggs and fry to reach eyed, hatching, and swim-up stages were less at 12 C than at 10 or 8 C. Total day-degrees required to reach an average weight of 0.5 or 0.6 g did not vary with temperature during hatching. (Chilton-ORNL)
W79-09579

HEMATOLOGICAL STRESS RESPONSE OF RAINBOW TROUT, SALMO GAIRDNERI, TO A SIMULATED GEOTHERMAL STEAM CONDENSATE SPILL,
California State Dept. of Fish and Game, Sacramento.
J. A. Steele, and L. A. Courtois.
California Fish and Game, Vol. 65, No. 3, p 166-167, July 1979. 7 ref.

Descriptors: *Environmental effects, *Thermal stress, Powerplants, Geothermal studies, Thermal springs, Rainbow trout, Fish kills, Hematology.

Rainbow trout were exposed to a condensate collected from Geysers Power Plant, California, which was diluted with filtered river water. The mixture represented a 15% volume/volume addition to a stream. Blood from the fish was collected at 0, 2, 23, and 93 hrs from the beginning of the exposure. Extreme physiological differences were evident between control and test fish blood parameters. Ammonia and carbon dioxide were high up to 23 hr but returned to pre-test levels by 93 hrs. Dissolved oxygen decreased by 1.0 ppm following introduction of condensate and then returned to pre-test levels. Mean corpuscular hemoglobin concentration increased sharply following addition of condensate, dropped below normal, and then remained significantly above control levels for duration of the test. (Chilton-ORNL)
W79-09580

5D. Waste Treatment Processes

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME III. TECHNICAL APPENDIX,
Texas Governor's Planning Committee.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 846, Price codes: A07 in paper copy, A01 in microfiche. U.S. Army Corps of Engineers, Fort Worth District, September 1973, 150 p.

Descriptors: *Water quality, *Waste water treatment, *Waste water disposal, *Water pollution treatment, *Costs, *Land treatment, *Water quality management(Applied), *Colorado River Basin(TX), *Texas, Activated sludge treatment, Lime clarification, Nitrification, Biochemical oxygen demand, Runoff, Infiltration, Capital costs, Water pollution, Planning, Tertiary treatment, Primary treatment.

The objective of this study is to develop the most cost-effective strategy to meet stream water quality criteria for the 50-year planning period 1970-2020. The first section of this volume presents a collection of curves used in estimating costs of collection systems and treatment facilities. Data were gathered from both current literature and recent bid tabulations for similar construction. These cost curves include sanitary sewere, lift stations, activated sludge treatment plants, wastewater stabilization ponds, and tertiary treatment plants. Land application of sewage effluent is described and three basic techniques of land disposal discussed. The rationale for designating the treatment level is described. Because advanced treatment facilities are expensive, it becomes necessary to devise a schedule for implementation of advanced wastewater treatment facilities that allows for phasing of construction and funding. Different treatment methods and facilities are described. An evaluation of wastewater treatment process efficiencies is presented. A listing of base data and a bibliography of publications utilized during the study is included, as well as a glossary and water usage parameters. (See also W79-09331) (Coan-NC)
W79-09333

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME V. UPPER BASIN,
Texas Governor's Planning Committee.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 848, Price codes: A12 in paper copy, A01 in microfiche. U.S. Army Corps of Engineers, Fort Worth District, September 1973, 255 p, 9 append, 25 plates, 12 tab.

Descriptors: *Waste water treatment, *Waste treatment, *Water pollution, *Water resources, *Regional planning, *Planning, *Water quality management(Applied), *Waste loads, *Texas, *Colorado River Basin(TX), Land resources, Land use, Solid waste, Hydrology, Geology, Costs, Capital costs, Operating costs, Maintenance costs, Economics, Population, Soils, Land treatment, Odessa(TX), Midland(TX), Big Spring(TX).

The objective of this study is the development of the most cost-effective strategy to meet stream water quality criteria for the 50-year planning period 1970-2020. This volume contains the areawide planning documents pertaining to the Upper Colorado Basin Planning Area primarily covering the planning jurisdiction of the Permian Basin Regional Planning Commission (PBRPC). Three communities in the PBRPC jurisdiction are described--Big Spring, Midland and Odessa. The general characteristics of the PBRPC region are presented--physical and socio-economic--along with existing waste loads. The three metropolitan areas are described; descriptions of water resources and supply, waste load analysis, industrial wastes and waste load allocation, and municipal wastewater collection and treatment systems are presented. Twelve alternatives were considered, and, for each municipality, alternative 1 was selected as the best plan. This included modification and expansion of existing facilities and load disposal for Big Spring; use of the existing secondary treatment plant and total irrigation as currently practiced for Midland; and expansion of the existing secondary treatment plus industrial reuse of effluent for Odessa. The municipalities' wastewater collection systems, proposed collection systems and their costs, and existing wastewater treatment systems and some alternatives are described, as well as detailed economic and evaluation analyses of the proposed alternatives. Areawide plans are also presented for nine other communities in the PBRPC jurisdiction. A description is presented of the South Plains Association of Governments (SPAG) and areawide plans presented for six communities within its jurisdiction. (See also W79-09331) (Coan-NC)
W79-09335

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME VI. CENTRAL BASIN,
Texas Governor's Planning Committee.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 849, Price codes: A16 in paper copy, A01 in microfiche. U.S. Army Corps of Engineers, Fort Worth District, September 1973, 365 p, 6 append, 40 plates, 16 tab.

Descriptors: *Waste water treatment, *Waste treatment, *Water pollution, *Regional planning, *Planning, *Water quality management(Applied), *Water resources, *Texas, *Colorado River Basin(TX), *Waste loads, Solid waste, Hydrology, Geology, Costs, Capital costs, Operating costs, Maintenance costs, Economics, Population, Soils, Sewerage, Land use, Land resources.

The objective of this study is the development of the most cost-effective strategy to meet stream water criteria for the 50-year planning period 1970-2020. This volume contains the areawide planning documents pertaining to the Central Basin Planning Area. The scope of the study covers the planning areas of the Alamo area, Central Texas, Concho Valley, West Central Texas Councils of Governments, and Middle Rio Grande Development Council. For each planning council, the report describes their respective planning authority, the physical characteristics of each planning area, the socio-economic characteristics, and existing wasteloads. Physical characteristics described include climate, hydrology, water resources, and geology, and socio-economic characteristics are comprised of population, land use and each area's economic base. The areawide plans of the most important non-metropolitan areas are described. This plan contains a discussion of water use, waste load, and population projections, and influent-effluent data. Some regional councils contain major metropolitan areas and the respective areawide plans for these jurisdictions are presented. The report presents the municipalities' wastewater collection systems, proposed collection systems and their costs, existing wastewater treatment systems, and alternatives to the treatment system. The appendices present a detailed economic and evaluation analysis of the alternatives including cost summaries and comparisons, and environmental, social, and economic impacts of the alternatives. (See also W79-09331) (Coan-NC)
W79-09336

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME VII. LOWER BASIN,
Texas Governor's Planning Committee.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 850, Price codes: A19 in paper copy, A01 in microfiche. U.S. Army Corps of Engineers, Fort Worth District, September 1973, 433 p, 5 append, 47 plates, 48 tab.

Descriptors: *Waste water treatment, *Waste treatment, *Water pollution, *Water resources, *Regional planning, *Planning, *Texas, *Colorado River Basin(TX), *Austin(TX), Travis County(TX), Waste loads, Land resources, Land use, Solid waste, Hydrology, Geology, Costs, Capital costs, Operation costs, Maintenance costs, Economics, Population, Soils, Sewerage, Water quality management(Applied).

The objective of this study is the development of the most cost-effective strategy to meet stream water criteria for the 50-year planning period 1970-2020. This volume contains the areawide planning documents pertaining to the lower Basin covering the planning jurisdictions of the Capital Area Planning Council (CAPCO) and the Houston-Galveston Area Council (H-GAC). First, the CAPCO planning jurisdiction is described--its institutional structure, a physical and socio-economic description of the area, population analysis and projections, water use requirements and water supplies, and existing industrial and agricultural operations and their waste loads. An in-depth look at the metropolitan plan for Austin is then presented, with descriptions of the topography, geology, population projections, water resources, existing sewerage collection and treatment systems, agricultural and urban runoff, and proposed wastewater collection and treatment systems. An economic and evaluation analysis of alternatives to the existing wastewater collection system with cost comparisons, and summaries and various impacts of the alternatives is presented, as well as an evaluation of land disposal methods. Plans are presented for each of the public wastewater treatment facilities in the non-metropolitan areas of CAPCO to meet federal water quality standards in the most cost-effective manner. The basic criteria for these plans are population projections, waste loads, degree of treatment, and cost. The areawide plan for H-GAC area is presented which is similar in scope to the CAPCO plan but with fewer non-metropolitan areas. (See also W79-09331) (Coan-NC)
W79-09337

NASA JSC WATER MONITOR SYSTEM--CITY OF HOUSTON FIELD DEMONSTRATION,
National Aeronautics and Space Administration, Houston, TX. Lyndon B. Johnson Space Center.
R. E. Taylor, E. L. Jeffers, and D. H. Fricks.
Report No. NASA RP-1041, July 1979. 55 p, 17 fig, 13 tab, 2 append.

Descriptors: *Water quality, *Reclaimed water, *Water reuse, *Monitoring, *Effluents, Houston(Texas), Bioluminescence, Domestic water, Biosensors, Coliforms, Water sampling, Waste identification, Coliforms, Water sampling, Waste identification, Microorganisms, Chemiluminescence, Sewage treatment.

A system to perform automated water quality monitoring on-line and in real time, much as it would be done in a spacecraft was developed. The system has the capability to determine conformance to future high effluent quality standards and to increase the potential for reclamation and reuse of water. Included in the system are conventional commercial sensors, advanced organic sensors, NASA-developed microorganism sensors, an automated sample collection system, and a data acquisition and display system that also has the capability to automatically control and standardize the sen-

sors. Following a description of the system, test support, field testing, and results are discussed. Field testing was designed to demonstrate system operation and effectiveness in monitoring in-process fluid and effluent from an actual wastewater treatment facility. Fully automated operation over a sustained period which only routine manual adjustments was accomplished. Sensors were calibrated under softwave control and returned to service for continuous monitoring. Reports were generated on an hourly basis from data stored on disks. Results show that the monitoring system has great potential in water monitoring and for process control applications and that it represents a vast improvement over conventional (grab sample) water monitoring techniques. (Seigler-IPA)
W79-09432

TREATMENT OF WASTE WATER,
British Oxygen Co. Ltd., London (England). (Assignee).
K. C. Smith, and M. E. Garrett.
U.S. Patent No. 4,141,823, 7 p, 5 fig, 5 ref; Official Gazette of the United States Patent Office, Vol. 979, No. 4, p 1425-1426, February 27, 1979.

Descriptors: *Patents, *Waste water treatment, *Sewage treatment, *Water pollution treatment, Aerobic conditions, Aerobic bacteria, Oxygen, Biochemical oxygen demand, Equipment.

A process for treating aqueous waste material having a biochemical oxygen demand comprises passing the aqueous waste material along an elongate treatment tank or other elongate container. The container has a transverse support structure or structures extending along its length to support aerobic microorganisms. The support structures can take the form of spaced apart pieces of wire mesh or coiled strand-like material with passages for liquid flow. Preferably the support structures are removable from the tank for cleaning purposes. An oxygenating gas is introduced into the interior of the container at a number of positions spaced along its length. (Sinha-OEIS)
W79-09509

TREATMENT OF ACRYLONITRILE WASTE WATER WITH ACTIVATED CARBON,
Standard Oil Co. (OH), Cleveland. (Assignee).
H. E. Alford, and K. L. Bigler.
U.S. Patent No. 4,141,826, 8 p, 1 fig, 8 ref; Official Gazette of the United States Patent Office, Vol. 979, No. 4, p 1426-1427, February 27, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Organic wastes, Activated carbon, Adsorption, Regeneration, Product recovery, Acrylonitrile.

Waste water from an acrylonitrile-manufacturing plant is contacted with activated carbon in a series of activated carbon beds so that valuable organic components in the waste stream, e.g. acrylonitrile and acrylic acid, are adsorbed. The waste water passing out of the activated carbon beds can be distilled if desired without encountering the fouling problem associated with distilling raw acrylonitrile waste water so that the volume of waste water which must be discharged is significantly reduced. The activated carbon is periodically regenerated with a desorbing liquid and the desorbate product is distilled to yield acrylonitrile and acrylic acid. Every fifth regeneration cycle, the activated carbon is regenerated thermally rather than by means of a liquid in order to restore its activity to its original value. (Sinha-OEIS)
W79-09512

PROCESS FOR CLARIFYING COAL WASH WATERS,
American Cyanamid Co., Stamford, CT. (Assignee).
A. T. Coscia, and M. N. D. O'Connor.
U.S. Patent No. 4,141,827, 6 p, 2 tab, 9 ref; Official Gazette of the United States Patent Office, Vol. 979, No. 4, p 1427, February 27, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Separation techniques, Suspended solids, Water purification, Polymers, Flocculation, Coal wash waters, Low molecular weight polymers.

A process is provided for settling suspended solids in coal washing waste water which comprises mixing with the water an effective amount of a polymer of low molecular weight. The low molecular weight polymers provide small absorbent flocs which can absorb additional suspended solids and provide greater clarification. After the polymer has been mixed with the waste water, the solids are settled to provide a clarified supernatant liquid which may be separated from the settled solids by suitable means, such as by decantation, filtration, centrifugation and the like. (Sinha-OEIS)
W79-09513

PROCESS FOR TREATING WASTE WATER,
Osaka Gas Co. Ltd. (Japan). (Assignee).
N. Okada, Y. Nakanishi, and Y. Harada.
U.S. Patent No. 4,141,828, 9 p, 2 fig, 9 tab, 9 ref; Official Gazette of the United States Patent Office, Vol. 979, No. 4, p 1427, February 27, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Ammonia, Nitrogen, Industrial wastes, Oxidation, Oxygen, Chemical oxygen demand, Catalysts, Wet oxidation.

A process for treating ammonia-containing waste water comprises subjecting the ammonia-containing water to wet oxidation with an oxygen-containing gas in the presence of a catalyst while maintaining the waste water at a temperature of 100 to 370 degrees C and at pressure permitting the waste water to remain in the liquid phase. The catalyst comprises at least one of iron, cobalt, nickel, ruthenium, rhodium, palladium, iridium, platinum, copper, gold, tungsten and compounds of these metals which are insoluble in water. It is preferable to remove suspended solids partly or wholly from the waste water prior to the treatment depending on the concentration and composition of the solids. (Sinha-OEIS)
W79-09514

PROCESS FOR WET OXIDATION OF ORGANIC SUBSTANCES,
Farbenfabriken Bayer A. G., Leverkusen (Germany, F.R.).
R. Thiel, K-H. Dietz, H. Kerres, and H. J. Rosenbaum.
U.S. Patent No. 4,141,829, 8 p, 1 fig, 11 ref; Official Gazette of the United States Patent Office, Vol. 979, No. 4, p 1427-1428, February 27, 1979.

Descriptors: *Patents, *Waste water treatment, *Organic wastes, *Water pollution treatment, *Oxidation, Oxygen, Separation techniques, Evaporation, Carbon dioxide, Wet oxidation.

A process has been developed for the oxidation of organic substances, dissolved or dispersed in an aqueous system, with a gas containing molecular oxygen at elevated temperature and under elevated pressure chiefly to carbon dioxide and water, with subsequent phase separation of the reaction mixture into a gaseous phase substantially containing inert gas, carbon dioxide, steam and organic constituents and a liquid phase substantially containing water, characterized in that the pressure is adjusted, at the given temperature, so that by evaporation of water from the aqueous system, more steam than the exothermicity of the oxidation reaction gives rise to, goes into the gaseous phase, which is fed to a heat exchanger in which the amount of heat required to maintain the oxidation temperature is completely or partially transferred to a mixture of water and a gas containing molecular oxygen, which mixture flows in on the other side of the heat exchanger and is subsequently fed to the reactor. A particular advantage of the process is that, in addition to the oxidation of organic substances, it is possible to feed inorganic constituents, after the oxidative degradation of the organic substances, to a re-use or recovery process. (Sinha-OEIS)
W79-09515

MEMBRANE SEPARATION OF WATER FROM AQUEOUS MIXTURES,
Monsanto Co., St. Louis, MO. (Assignee).
For primary bibliographic entry see Field 5G.
W79-09520

METHOD AND APPARATUS FOR MECHANICALLY AND CHEMICALLY TREATING LIQUIDS,
Passavent-Werke Michelbacher Huette, Aarbergen (Germany, F.R.). (Assignee).
G. von Hagel, and N. Berlenbach.
U.S. Patent No. 4,142,970, 10 p, 5 fig, 5 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 1, p 244, March 6, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Separation techniques, Flocculation, Flow, Equipment, Sedimentation zone.

A new and improved method for treating waste water by a mechanical and chemical technique is described. Liquid to be treated flows into a combined sedimentation and thickening tank. The upper part of the tank is a sedimentation zone in which the liquid passes through parallel flow paths between downwardly inclined separator plates below which the solids fall to the bottom of the tank into the thickening zone where the solids are stirred and removed by a suitable stirring and scraping device. The liquids flowing with the solids through the parallel paths are removed at the end of the paths and delivered directly to the top of the sedimentation zone thus leaving the thickening zone essentially flow-free. Flocculants may be added to the water to be treated in a separate flocculation compartment arranged upstream from the sedimentation compartment. A separate destabilization compartment may be provided upstream from the flocculation compartment. A square sedimentation zone may merge smoothly into a circular thickening zone. The thickening zone may extend beneath the flocculation compartment for compactness. The scraping and stirring device may be rotatable or movable along a straight path. (Sinha-OEIS)
W79-09522

APPARATUS FOR THE TREATMENT OF SEWAGE,
Sanilogical Corp., Denver, CO. (Assignee).
J. Kinzer.
U.S. Patent No. 4,142,975, 13 p, 10 fig, 3 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 1, p 246, March 6, 1979.

Descriptors: *Patents, *Waste water treatment, *Sewage treatment, *Aerobic conditions, Organic wastes, Mixing, Oxygenation, Microorganisms, Equipment, Autodigestion.

An apparatus for treating sewage to obtain substantially complete organic matter substrate and biological sludge oxidation prior to effluent discharge comprises a series of treatment units. Each unit has a generally circular cross-section configuration and means for providing fluid communication between each successive unit of the series. The system provides for a uniform, complete and thorough intermixing of mixed liquor and suspended solids throughout each treatment chamber thereby eliminating the settling of any biological sludge. It also provides for uniform dispersal and intimate contacting of oxygen with mixed liquor and suspended solids throughout the treatment chamber thereby providing a suitable environment for continuous aerobic activity of microorganisms. Serial fluid communication between units of the series provides an environment suitable for organic matter substrate consumption and microorganism generation and development in an initial unit of the series, an environment suitable for microorganism population maintenance in an intermediate unit of the series, and an environment suitable for forced autodigestion of the microorganisms in the latter units of the series, thereby eliminating biological sludge produced in the microorganism development phase. (Sinha - OEIS)
W79-09523

METHOD FOR WORKING UP AQUEOUS RESIDUES FROM METALLIZING BATHS,
Brown, Boveri and Co. Ltd., Baden (Switzerland). (Assignee).
H. Bollhalder, and V. Sova.
U.S. Patent No. 4,144,149, 5 p, 7 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 2, p 631, March 13, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Industrial wastes, *Separation techniques, Metals, Copper, Heavy metals, Electrolysis, Anion exchange, Chelating agents, Ethylenediaminetetraacetic acid(EDTA).

The object of this invention is to provide a technique for purifying aqueous residues from exhausted metallizing baths, especially coppering baths which operate without external current, which contain at least one amino compound as a complex-forming agent or chelating agent, to produce an effluent virtually free from heavy metal ions such that it can be fed without dilution into the communal sewerage system or a drain. This and other objects have been achieved by the method where aqueous residue containing heavy metal ions and an amino-containing compound as a complex-forming agent, as the free acid or as a salt, is subjected to an anodic treatment in order to eliminate the complexing ability of the amino compound. The anodic treatment is preferably carried out as an electrolysis of the aqueous residue, and deposition of the heavy metal on the cathode can take place simultaneous with anodic treatment. (Sinha - OEIS)
W79-09526

SEWAGE TREATMENT SYSTEM,
A. L. Burkett, and A. O. Nelson.
U.S. Patent No. 4,144,167, 12 p, 8 fig, 10 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 2, p 635, March 13, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Sewage treatment, Separation techniques, Centrifugation, Aeration, Impaired water quality, Reclaimed water, Equipment, Fertilizers.

The sewage treatment system includes an evacuator means for extracting raw aquaous sewage from sewer pipes, or other sources, and supplying the extracted sewage to an especially configured centrifugal mill. The centrifugal mill applies high speed mechanical forces to the incoming sewage for disintegration of the solids and thorough aeration of the liquids. The flow rate of the incoming sewage through the centrifugal mill is maintained at a rate which assures that the mill's rotors are not required to operate under an aqueous medium and air is admitted to the mill in sufficient amounts to insure complete aeration. In this manner, the drive equipment size and power consumption are held to a minimum and relatively high rotor speeds are attainable to cause introduction of large quantities of air which satisfies the biochemical oxygen demand of the sewage and produces odor free by-products. The odor free by-products emerge tangentially from the centrifugal mill and are fed through a self cleaning screen means which separates the disintegrated or pulpy solids and delivers reclaimed water which can then be used for crop irrigation, equipment cooling and the like. (Sinha-OEIS)
W79-09527

APPARATUS FOR WATER TREATMENT,
K. R. Dunkers.
U.S. Patent No. 4,144,170, 10 p, 7 fig, 5 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 2, p 636-637, March 13, 1979.

Descriptors: *Patents, *Water treatment, *Water pollution treatment, Sewage treatment, Separation techniques, Floating, Aeration, Flow separation, Baffles, Storm water, Equipment.

An apparatus for treatment of water comprises inclined lamellae arranged so that settling materials as well as floating materials are separated from the water. The apparatus is devised so that the water flows in opposite directions through separate spaces between the lamallae, wherein heavy materials (sludge) settle to the bottoms of the spaces while floating materials (scum) are retained and separated in a chamber where the water changes its direction of flow. The apparatus may be arranged for separation of sludge in two fractions and for purification of the water by a combination of flotation by aeration and settling. The apparatus is useful for all types of purification processes based on separation by settling and flotation within the water and sewage treatment art. Especially of interest is the favorable application of the apparatus for treating storm water and overflow water. (Sinha-OEIS)
W79-09528

MODULAR DRAIN FIELD SECTION,
D. J. Lascelles.
U.S. Patent No. 4,145,157, 5 p, 5 fig, 5 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 3, p 974, March 20, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Soil disposal fields, Sewage treatment, Domestic wastes.

A modular drain field section and a method for making a drain field section are disclosed having upper and lower casings which are connected together to form each drain field section. Both upper and lower casings have a center pipe portion which, when connected together, forms a central pipe and each casing has troughs on both sides of the center pipe portion. The lower casing troughs have openings and a spillway connects the central pipe with the lower casing troughs. The modular drain field sections are connected together to form a drain field without the use of rock media, fill, drain tile, grace board or felt paper. A method of making the modular drain field sections includes using the same mold both for the upper and lower casings. (Sinha-OEIS)
W79-09529

WATER RECYCLING SYSTEM,
Pure Cycle Corp., Boulder, CO. (Assignee).
H. W. Selby, III.
U.S. Patent No. 4,145,279, 8 p, 3 fig, 22 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 3, p 1013-1014, March 20, 1979.

Descriptors: *Patents, *Waste water treatment, *Monitoring, *Control systems, Water utilization, Water reuse, Domestic wastes, Ion exchange, Recirculated water, Water conservation, *Closed recycling system, Regeneration, Ultrafiltration.

A closed water recycling system produces potable drinking water from total domestic waste-water, including household sewage. A microprocessor monitors the operation of the system and automatically back-flushes the ultra-filter assembly, regenerates the ion exchange bed when the monitored variables indicate that this is necessary, and acts as a failsafe monitor to insure water quality by shutting down the system in case of a malfunction. For example, the bed includes acid and base regenerated resins having different specific gravities. When a monitor indicates that the bed requires regeneration, a water flush separates resins by specific gravity. Acid and base regenerating solutions are supplied to opposite sides of the bed. The flow of regenerating solution is stopped when the salt band produced during regeneration approaches an outlet at the middle of the bed. By stopping regeneration before excess regenerative has entered the bed, a saving in regenerating solution is effected and reduction in rinse water is effected, keeping the water losses from regeneration to a minimum. (It is desireable to have only a small amount of by-product water of high salt content to dispose of.) In a preferred embodiment, a rotational digestor has a wheel which evaporates the waste-water solution. (Sinha - OEIS)
W79-09531

METHOD AND DEVICE FOR SEPARATING A MIXTURE,
Ballast-Nedam Groep N.V., Amstelveen (Netherlands). (Assignees); and Skimovex B.V., Hague (Netherlands). (Assignees).
C. G. Middelbeek, M. E. Polano, and T. A. Wolters.
U.S. Patent No. 4,145,280, 17 p, 26 fig, 13 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 3, p 1014, March 20, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Separation techniques, Filtration, Coagulation, Equipment, Flushing, Regeneration.

A method of separating a mixture of a carrier medium and at least one insoluble substance is described, for example, water and oil or gas and soot, in which the mixture is separated in three steps. In a first step the mixture is passed for coalescence of the substance through a first packet of moving filter material. In a second step the substance coalesced segregates from the mixture by gravity and in a third step the remainder of the substance and the other packet of filter material is filtered out. The invention furthermore provides a device specifically intended to separate a mixture by carrying out the method. (Sinha - OEIS)
W79-09532

PROCESS FOR PURIFYING WASTE WATER CONTAINING FLUORIDE ION,
Andco Industries, Inc., Cheektowaga, NY. (Assignee).
S. Bruckenstein.
U.S. Patent No. 4,145,282, 8 p, 4 tab, 8 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 3, p 1014, March 20, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Industrial wastes, *Fluorides, Separation techniques, Chemical precipitation, Calcium, Phosphates, Fluorapatite.

A process for purifying waste water containing fluoride comprises precipitating fluoride from the waste water as fluorapatite. Fluoride is removed as fluorapatite by having sufficient available calcium for each mole of fluoride present in the waste water and sufficient available phosphate for each mole of fluoride in the waste water to form a precipitate which is or converts to sufficient fluorapatite to remove essentially all fluoride from the waste water. The precipitate which forms in a waste water stream as a result of either the continuous or batch process of the invention may be removed by passing the waste water through a settling tank having sufficient residence time to permit the precipitate to be removed by settling or alternatively the waste water may be passed through a filter or centrifuge to remove the precipitate. (Sinha-OEIS)
W79-09534

AUTOMATIC SYSTEM FOR TRAPPING AND REMOVING WASTE HYDROCARBONS FROM WATER,
F. P. Bereskin, and J. J. Borowczyk.
U.S. Patent No. 4,145,286, 6 p, 3 fig, 9 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 3, p 1015-1016, March 20, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Oil pollution, Oil wastes, Separation techniques, Specific gravity, Oil-water interfaces, Control systems, Hydrocarbons.

A system for waste oil recovery by flotation includes a main collection chamber for receiving influent waste water including oil, grease and other hydrocarbons, so that the hydrocarbons, having a lesser specific gravity than water and immiscible in water, will float, becoming an upper layer, the water settling in the chamber to become a lower layer. A water outlet regulates discharge of the water from the main collection chamber to keep the water at a desired level. A waste outlet regulates discharge of the hydrocarbons from a discharge opening or vent which is at a higher level or height than the water outlet. A control means is provided for automatically initiating the waste removal cycle by controlling the outlet and inlet

opening to admit fluid to raise the waste level and discharge and waste hydrocarbons through the discharge opening. The waste removal cycle is then automatically terminated and the collection chamber is returned to a normal flow-through operation. (Sinha-OEIS)
W79-09535

PROCESS FOR THE PURIFICATION OF WASTE WATER,
Hoechst A. G., Frankfurt au Main (Germany, F.R.).
A. Topp, K. Schmiedel, and G. Schaeffer.
U.S. Patent No. 4,145,283, 5 p, 3 tab, 7 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 3, p 1014-1015, March 20, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Chemical wastes, Water purification, Separation techniques, Oxidation, Oxygen, Temperature, Pressure, Chemical precipitation, Byproducts, Wet oxidation.

A process is provided for purifying waste waters formed by the preparation of hydroxy aromatics by a caustic alkaline melt of aryl-sulfonic acids or arylsufonates that is not only simple and economical, but also provides, as by-product, a salt of sufficient purity that is suitable for further direct use. The waste liquor is subjected to a wet oxidation process with oxygen or oxygen-containing gases at elevated temperature and under elevated pressure. (Sinha-OEIS)
W79-09536

GREASE AND WATER SEPARATING APPARATUS,
H. L. Walker, and D. B. David.
U.S. Patent No. 4,145,287, 11 p, 12 fig, 16 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 3, p 1016, March 20, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Separation techniques, Industrial wastes, Equipment, Specific gravity, Byproducts, Grease.

An apparatus separates grease from a waste effluent containing a grease and water mixture prior to disposing of the effluent in a sanitary sewage system. A separator tank receives and holds the effluent while the mixture separates into an upper grease fraction and a lower water fraction. A means is provided for introducing the effluent into the tank either periodically or directly from the source of the effluent. A withdrawal means is associated with the tank for withdrawing at least a portion of the water fraction from the tank when the effluent in the tank reaches a predetermined level. The withdrawal means stop withdrawing the water fraction when the effluent in the tank reaches a second predetermined level lower than the first level. The grease can be stored in the separator tank itself or can be transferred to a separate storage tank. The water is disposed of directly to the sewer system while the grease is periodically collected for reprocessing into usable byproducts. (Sinha-OEIS)
W79-09537

A REVIEW OF THE ENVIRONMENTAL IMPACT OF GROUND DISPOSAL OF OIL SHALE WASTES,
Battelle Pacific Northwest Labs., Richland, WA.
R. C. Routson, R. E. Wildung, and R. M. Bean.
Journal of Environmental Quality, Vol. 8, No. 1, p 14-19, 1979. 52 ref. DOE EY-76-C-06-1830.

Descriptors: *Environmental effects, *Water quality, Energy, Waste disposal, Mining, Groundwater, Oil shale extraction.

This review considers waste disposal methods for the major types of oil shale extraction process, the potential environmental impacts of waste disposal, mitigation of environmental effects, and further research needs. Retort waters, which are the principal wastes scheduled for ground disposal, contain complex, soluble organic components and the spent shales contain potentially leachable salts and organic pyrolytic products. It is suggested that current research should be directed to source characterization and monitoring, ground disposal methodology, hydrologic transport, and environmental effects. (Chilton-ORNL)
W79-09572

5F. Water Treatment and Quality Alteration

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME I. BASIN PLAN,
Texas Governor's Planning Committee.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 844, Price codes: A23 in paper copy, A01 in microfiche. U.S. Army Corps of Engineers, Fort Worth District, September 1973, 534 p, 23 fig, 74 plates, 23 tab.

Descriptors: *Water quality, *Water pollution, *Water resources, *Waste water treatment, *Waste water sources, *Water quality management(Applied), *Texas, *Colorado River Basin(TX), Water requirements, Land use, Geology, Irrigation, Hydropower, Mining, Archaeological resources, Fish, Wildlife, Climate, Planning, Urban runoff, Non-point pollution, Water pollution sources.

The objective of this study is the development of the most cost-effective strategy to meet stream water quality criteria for the 50-year planning period, 1970 to 2020. Alternatives considered include strategies and projects to approach no discharge of pollutants by 1985. The scope includes water resources, water quality, definition of the study area, wastewater sources, and alternatives for achieving water quality. The Colorado River Basin in Texas encompasses about 39,900 square miles extending across several basic physiographic provinces. The 1970 population was 834,747; predominant land use was range and unimproved pasture land and farming. Major water quality problems are stream imbalance caused by disproportionate amounts of secondary effluent and quality degradation caused by inflow of mineral salts. The only pollution-abatement measures initiated have been municipal secondary sewage treatment plants and industrial treatment facilities. The feasible alternatives for meeting water quality objectives in the study area include treatment, relocation of discharge, water re-use, and control of wastewater quantities by zoning and planned growth. Alternative funding levels and recommended funding levels are presented. The 'treatment' alternative is recommended, in conjunction with re-use and regionalization. (See also W79-09332 thru W79-09337) (Coan-NC)
W79-09331

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOL. II. BASIN PLAN APPENDIX,
Texas Governor's Planning Committee.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 845, Price codes: A16 in paper copy, A01 in microfiche. U.S. Army Corps of Engineers, Fort Worth District, September 1973, 365 p.

Descriptors: *Texas, *Waste water management, *Planning, *Population projections, *Ground water, *Ground water availability, *Waste water treatment, *Mathematical models, *Modeling, *Water quality control, *Colorado River Basin(TX), *Waste loads, Oil industry, Water pollution, Minerals, Advanced waste treatment, Simulation, Legal aspects, Regulations, Conservative minerals, Water quality standards, Public participation.

The objective of this study is the development of the most cost-effective strategy to meet stream water quality criteria for the 50-year period 1970 to 2020. This volume is an appendix to the Basin Plan presented in Vol. I. Population projections are made for the study area on three levels--county, representative cities, and selected rural areas. A listing of river mile keys is included. Ground water availability is discussed. The Basin is underlain by nine ground water reservoirs; the characteristics of each reservoir are presented. Oil and gas producing leases are investigated; the methodology used in the development of discharges ranking lists is presented. Waste level allocations for conservative minerals are set forth and the priority listing methodology developed for the report is discussed. The development and calibration of the water quality model for the Colorado River below Austin is presented verbatim, as are selected Texas Water Quality Board Regulations and proposed water quality standards for the Colorado River. The public involvement program is set out, including reports of public meetings and workshops. (See also W79-09331) (Cooper-NC)
W79-09332

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME III. TECHNICAL APPENDIX,
Texas Governor's Planning Committee.
For primary bibliographic entry see Field 5D.
W79-09333

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME IV. INSTITUTIONAL ARRANGEMENTS,
Texas Governor's Planning Committee.
For primary bibliographic entry see Field 6E.
W79-09334

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME V. UPPER BASIN,
Texas Governor's Planning Committee.
For primary bibliographic entry see Field 5D.
W79-09335

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME VI. CENTRAL BASIN,
Texas Governor's Planning Committee.
For primary bibliographic entry see Field 5D.
W79-09336

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME VII. LOWER BASIN,
Texas Governor's Planning Committee.
For primary bibliographic entry see Field 5D.
W79-09337

TANGENTIALLY FED UPFLOW SAND FILTER METHOD AND APPARATUS,
Midcon Pipeline Equipment Co., Houston, TX. (Assignee).
C. K. Smith.
U.S. Patent No. 4,141,824, 10 p, 7 fig, 25 ref; Official Gazette of the United States Patent Office, Vol. 979, No. 4, p 1426, February 27, 1979.

Descriptors: *Patents, *Water purification, *Water pollution treatment, *Filtration, Filters, Separation techniques, Sands, Biological treatment, Chlorination, Backwash.

Methods and apparatus for purifying water by filtration are described. Water is passed in an upward direction through one or more sand beds supported in towers, at a slow rate of flow so that the sand bed is not disturbed. The sand bed or layer is relatively deep vertically to provide superior filtration. Raw water feed to each tower is accomplished by tangential flow from the inlets. Rapid backwash of the sand bed is accomplished by opening a dump valve at the lower end of a cone provided at the base of the tower in which the sand bed is supported. Maintenance and control of bacterial activity in the lower part of the sand bed enhances purification of the water by bacterial action. Chemical treatments of the water may be used in conjunction with the filtration, including treatments with chlorine, and with alum (i.e. aluminum sulphate and/or potassium or am-

monium alum) to produce a floc, and barius sulphate and/or a drilling mud may be added to assist in removal of the floc by filtration. (Sinha-OEIS)
W79-09510

OZONE/ULTRAVIOLET WATER PURIFIER,
Ontario Research Foundation, Mississauga. (Assignee).
A. J. Last.
U.S. Patent No. 4,141,830, 5 p, 3 fig, 4 ref; Official Gazette of the United States Patent Office, Vol. 979, No. 4, p 1428, February 27, 1979.

Descriptors: *Patents, *Water treatment, *Water purification, Ultraviolet radiation, Ozone, Disinfection, Water quality control, Equipment.

Small amounts of ozone can be produced by an ultraviolet lamp which is simultaneously irradiating the water, and this small quantity of ozone is combined in the flowing water. This will place some residual ozone in the water for maintaining disinfection downstream of the irradiation location and will allow simultaneous disinfection with ozone and with ultraviolet. The apparatus consists of an ultraviolet light source which irradiates air passing through a first chamber surrounding the source, and then irradiates the liquid passing through the second chamber surrounding the first chamber. The air from the first chamber is ozonated by the ultraviolet light, and this air is bubbled into the water in the second chamber to maximize the purification through simultaneous ultraviolet and ozone exposure. (Sinha - OEIS)
W79-09516

5G. Water Quality Control

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME I. BASIN PLAN,
Texas Governor's Planning Committee.
For primary bibliographic entry see Field 5F.
W79-09331

PLANNING WATER USE AND QUALITY CONTROL IN A RIVER BASIN,
Akademiya Nauk SSSR, Moscow.
For primary bibliographic entry see Field 6A.
W79-09436

MULTILEVEL APPROACH TO URBAN STORM WATER SYSTEMS PLANNING,
Purdue Univ., Lafayette, IN.
For primary bibliographic entry see Field 6A.
W79-09488

POLLUTION CONTROL MANUAL FOR IRRIGATED AGRICULTURE,
Toups Corp., Loveland, CO.
For primary bibliographic entry see Field 3F.
W79-09490

CROPPING AN ABANDONED FEEDLOT TO PREVENT DEEP PERCOLATION OF NITRATE-NITROGEN,
Science and Education Administration, Cheyenne, WY.
G. E. Schuman, and L. F. Elliott.
Soil Science, Vol. 126, No. 4, p 237-243, October, 1978. 6 fig, 2 tab, 6 ref.

Descriptors: *Nitrogen, Nitrates, Feed lots, Water quality control, *Groundwater, *Leachate, Crop production.

An abandoned feedlot was cropped to corn (Zea mays L.) and alfalfa (Medicago sativa L.) to prevent excess buildup and deep percolation of NO3-N from the organic and NH4-N accumulations from the feedlot operation. To eliminate part of the N and salt accumulations, 15 cm of surface material was removed from half the plots and replaced with field soil. Alfalfa production was 14.1 and 11.8 metric tons/ha, and corn forage production was 8.0 and 6.7 metric tons/ha, from the intact surface and removed surface treatments, respectively. Nitrogen uptake was two and one-half to three times greater for alfalfa than for corn, which was reflected by the NO3-N content of the respective soil profiles. Nitrate-N content of the corn forage exceeded 2000 ppm (above the acceptable limit for livestock consumption), whereas the alfalfa averaged only 857 ppm, which would allow using it as a feed without ensiling. Nitrate buildup in the soil profiles was greater when the surface material remained in place; the results indicated that with proper cropping, however, either method would prevent excess NO3-N accumulation. (Skogerboe-Colorado State)
W79-09500

OCEAN OIL SKIMMER FOR CONTINUOUS REMOVAL OF OIL FROM THE OPEN SEA METHOD,
Texaco Inc., New York. (Assignee).
I. C. Pogonowski, and J. R. Fowler.
U.S. Patent No. 4,136,008, 8 p, 9 fig, 3 ref; Official Gazette of the United States Patent Office, Vol. 978, no 4, p 1384, January 23, 1979.

Descriptors: *Patents, *Oil pollution, *Water pollution treatment, *Water quality control, Oil spills, Specific gravity, Flow, Skimming, Equipment.

A method is disclosed for continuously removing a film of pollutant, as oil, from floating on the water solely by gravity forces. The apparatus comprises a closed top collecting vessel or tank of water elevated above the oil recovered water with a large conduit extending from the bottom of the tank down into the oil, so that as the oil continuously and uninterruptedly floats up internally of the conduit and tank to the top of the tank, the water is simultaneously and continuously displaced and sinks down through the tank and conduit to the water below. With a number of tanks filled with water mounted not higher than 33 feet on a barge being pulled behind a barrier for gathering and banking up the oil just ahead of the barge, a floating pollutant or oil removal system is formed by extending conduits from the bottoms of the water tanks sloping downwardly over the barrier into the floating oil. After establishing a continuous exchange of the oil for the water in the tank by continuous gravity flow of both the oil and the water through the interconnecting conduit in opposite directions simultaneously, the conduit lower end may then be lowered slightly below the interface between the oil and the water, particularly when inadvertently lowered as the layer of oil becomes thin, for continued replacement of the water in the tank with the oil from below. As the oil rises continuously in the conduits and tanks to the top of the tanks, the water simultaneously and continuously sinks down to the water below to accordingly pick up only pollutants of lower density than water, as oil or oil emulsions. (Sinha-OEIS)
W79-09506

AQUATIC DEBRIS REMOVING SYSTEM,
R. H. Gainey.
U.S. Patent No. 4,141,308, 7 p, 4 fig, 13 ref; Official Gazette of the United States Patent Office, Vol. 979, No. 4, p 1260, February 27, 1979.

Descriptors: *Patents, *Water pollution treatment, *Water quality control, Oil pollution, Flotsam, Mechanical equipment, Jets, Scooping, Air jet propulsion.

An improved mobile scooping and loading machine used to remove floating debris from waterways regardless of the depth of the water consists of a boom-operated scoop. Its interaction with an air jet propelling mechanism is used first to collect the debris to be removed, second to accumulate any floating hydrocarbon slicks onto the surface of the debris, and third to counterbalance the weight of the load to be transported to the disposal site by use of a horizontal runner placed behind the air jet propelling mechanism. (Sinha - OEIS)
W79-09507

MEMBRANE SEPARATION OF WATER FROM AQUEOUS MIXTURES,
Monsanto Co., St. Louis, MO. (Assignee).
E. Perry.
U.S. Patent No. 4,142,966, 5 p, 1 tab, 7 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 1, p 244, March 6, 1979.

Descriptors: *Patents, *Water treatment, *Waste water treatment, *Water quality control, *Separation techniques, Water purification, Membrane processes, Permselective membranes, Desalination.

Water is separated from aqueous mixtures through the use of polymeric membranes selectively permeable to water, together with a water miscible sweep liquid having a critical phase separation temperature with respect to water within the thermostability range of the membrane. An essential feature of the water-separation process is that the water miscible liquid have a normal or inverted, thermal-water miscibiligy curve. The selection of the water-miscible liquid promotes a separation process wherein a minimum energy input is required for the separation of water from the sweep liquid, without the necessity of a change in phase. An additional essential feature is that the polymeric membrane be selectively permeable to water as compared to other components. The process has the following steps: (1) contacting aqueous mixtures with a first surface of a polymeric membrane selectively permeable to water; (2) permeating a portion of the water into and through the membrane; (3) contacting a second surface of the membrane with a water miscible liquid having a thermally dependent water miscibility within the stable temperature range of the membrane; (4) withdrawing a water enriched miscible liquid from the second membrane surface; and (5) forming a water rich phase and a miscible liquid phase through the thermal adjustment of the withdrawn water-enriched miscible liquid. (Sinha-OEIS)
W79-09520

COMPOSITION AND PROCESS FOR SELECTIVELY REMOVING OLEAGINOUS PRODUCTS FROM WATER,
R. S. Funk, D. W. Mogg, and D. L. Ruff.
U.S. Patent No. 4,142,969, 5 p, 1 tab, 8 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 1, p 244, March 6, 1979.

Descriptors: *Patents, *Oil pollution, *Water pollution treatment, *Water quality control, Oil spills, Absorption, Cellulose, Selectivity, Oleophilic properties, Expanded volcanic glass.

This invention provides a composition comprising a specific volcanic glass and vegetable fibers, like cellulosic fibers, both of which are normally nonselectively oleophilic and hydrophilic, to sorb selectively oil from water. The composition is characterized further by having essentially spheroidal spaces or voids and elongated spaces, the former in the expanded perlite or like volcanic glass and the latter with the cellulosic fibers. It is capable of selectively sorbing oil from water and floating at the interface of the two liquids essentially indefinitely. The composition is principally an expanded volcanic glass compounded with the fibers positioned principally between the particles of the expanded mineral to form a network or skeleton of fibers. The fibrous component is treated with a water repellent sizing which renders the fibers hydrophobic (such as asphalt or pitch). The sizing also acts as a binder to hold the fiber and volcanic glass together. The product, cast on the water where oil spillage has occurred, floats, gradually sorbing the oil until the composition becomes essentially saturated, and is removed from the water by scooping up in suitable nets, rakes or other gathering devices. (Sinha-OEIS)
W79-09521

WATER PURIFICATION PROCESS,
Monsanto Co., St. Louis, MO. (Assignee).
M. F. Weishaar, and L. Ballard.
U.S. Patent No. 4,145,281, 6 p, 1 fig, 4 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 3, p 1014, March 20, 1979.

Descriptors: *Patents, *Water treatment, *Water purification, *Water quality control, Industrial

water, Cooling water, Metals, Chromium, Zinc, Ion exchange, Anion exchange, Cation exchange, Regeneration, Product recovery.

The waste water from cooling tower blowdown is preferably first prefiltered to remove suspended material. The pH of the blowdown is then controlled for example within a range of 4.5 to 4.9, such as by addition of a mineral acid, e.g. hydrochloric acid or sulfuric acid. The blowdown is then passed through at least one weakly basic ion exchange resin bed to remove hexavalent chromium. Zinc and trivalent chromium are removed by then passing the blowdown through at least one weakly acidic cation exchange resin bed in the alkaline form, alakline being herein defined as sodium, calcium, potassium or magnesium. After continued usage the anion and cation resins may then be regenerated, and chromium and zinc compounds may be recovered during regeneration of each column and either used in other processes or stored for reuse as corrosion inhibitors for cooling towers. (Sinha-OEIS)
W79-09533

SKIMMER FOR OIL SPILLS,
C. E. Nagy, and J. F. Nagy.
U.S. Patent No. 4,145,290, 19 p, 30 fig, 11 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 3, p 1017, March 20, 1979.

Descriptors: *Patents, *Oil spills, *Oil pollution, *Water pollution treatment, Water quality control, Skimming, Equipment, Flow control, Skimmers, Funnels

A skimmer is provided for removing oil spilled on the surface of a body of water. The skimmer has a hull which is submersiole in the water and a coupler on the nose of the hull for coupling the skimmer to a towing vehicle. A surge tank is located within the hull for receiving oil and water skimmed from the surface. A funnel positioned on top of the skimmer and extending through the hull has an inlet end positionable in the spilled oil and an outlet end extending into the surge tank. In one embodiment the inlet end comprises a pivotable head that is held level with the surface of the liquid by an attached float. A conveyor within the funnel controls the flow of oil and water into the surge tank. A sensor at the funnel inlet controls a hydraulic jack located between the funnel and the hull to position the inlet in the oil on the water's surface. A conduit is provided between the surge tank and a conduit coupler on the rear of the hull for use in pumping oil out of the surge tank and into an outside conduit. In a preferred embodiment, a pair of doors are hinged to the inlet end for either closing the funnel or for opening outward in a spread position to gather and channel the oil into the funnel. The doors can be joined to the ends of a floating fence so that oil confined within the fence is directed into the funnel as the skimmer and fence are pulled through the oil spill. (Sinha-OEIS)
W79-09538

SURFACE SKIMMER,
National Marine Service Inc., St. Louis, MO. (Assignee).
C. in'tVeld.
U.S. Patent No. 4,145,292, 7 p, 10 fig, 15 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 3, p 1018, March 20, 1979.

Descriptors: *Patents, *Oil pollution, *Water pollution treatment, *Water quality control, Skimming, Flow control, Barriers, Equipment, *Oil booms, Skimmers.

An oil boom for sweeping and collecting oil from the surface of a body of water is constructed of a framework of structural members arranged in the form of a box beam, the framework supporting two parallel rows of floating barrier screen panels and being connected to end floats. Flow diverter vanes beneath the barrier screen panels cause a surface transport current to flow between the two rows of the panels towards a surface skimmer located adjacent one end of the boom when the boom is towed in a direction transversely of its length across a body of water to be swept. The forwardmost row of barrier screen panels sweeps floating oil on the water surface towards the skimmer, and the transport current carries oil that is caught in the underflow beneath the forwardmost row of panels towards the skimmer. Extension arms including floating vertical barrier screen panels are pivotally attached to the boom to extend the sweep area, the arms being foldable inwardly against the central boom structure for stowage of the boom. (Sinha-OEIS)
W79-09539

CELLULOSE ESTER ULTRA-FILTRATION MEMBRANES AND THEIR MANUFACTURE,
Canadian Patents and Development Ltd., Ottawa (Ontario). (Assignee).
For primary bibliographic entry see Field 3A.
W79-09540

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOL. II. BASIN PLAN APPENDIX,
Texas Governor's Planning Committee.
For primary bibliographic entry see Field 5F.
W79-09332

PLAN OF STUDY FOR THE NORTHERN MIDWEST REGIONAL AQUIFER-SYSTEM ANALYSIS,
Geological Survey, Madison, WI. Water Resources Div.
W. L. Steinhilber, and H. L. Young.
Geological Survey Water-Resources Investigations 79-44 (open-file report), April 1979. 20 p, 2 fig, 7 ref.

Descriptors: *Aquifer management, *Project planning, *Regional analysis, *Hydrogeology, *Aquifer characteristics, Drawdown, Surface-groundwater relationships, Groundwater recharge, Groundwater availability, Water supply, Computer models, Geochemistry, Illinois, Indiana, Iowa, Minnesota, Missouri, Wisconsin, *Cambrian-Ordovician aquifer.

Sedimentary rocks of Cambrian and Ordovician age form a major aquifer system in most of Wisconsin and Iowa, northern Illinois, northwestern Indiana, southeastern Minnesota, and northern Missouri. Many metropolitan areas depend on the aquifer for all or part of their water supplies. Declines in potentiometric head have been large in the most heavily pumped areas, most notably Chicago, Milwaukee-Waukesha, Minneapolis-St. Paul, and Des Moines. A thorough understanding of the aquifer system is needed for sound management decisions. Thus, a 4-year study of the aquifer, beginning in October 1978, is included in the U.S. Geological Survey's program of Regional Aquifer-System Analysis. The study will evaluate the aquifer's water-supply potential, describe its water quality, and, through computer models of the ground-water flow system, provide the means to evaluate regional aquifer response to different patterns of ground-water development. This report describes the objectives, work plan, and organization of this study. (Woodard-USGS)
W79-09401

PLANNING WATER USE AND QUALITY CONTROL IN A RIVER BASIN,
Akademiya Nauk SSSR, Moscow.
V. G. Priazhinskaya, and I. L. Khranovich.
Hydrological Sciences Bulletin, Vol. 24, No. 2, p 239-247, June 1979. 3 ref.

Descriptors: *Planning, *Water quality, *Water demand, *Model studies, Mathematical models, Rivers, River basins, Water quality control, Pollutants, Path of pollutants, Water pollution, Water resources.

Quantity and quality control in a water resources system is considered to be an optimization problem on a graph with retarded controls, a non-convex biseparable objective function, and bilinear constraints which are equalities. Based on the branch and bound scheme, the solution of the problem with a given error was reduced to a finite series of convex estimating problems. (Sims-ISWS)
W79-09436

A PHANTOM DOCTRINE: THE ORIGINS AND EFFECTS OF JUST V. MARINETTE COUNTY (CONTROL OF LAKE SHORE EROSION THROUGH FILL PERMITS),
Minnesota Univ., Minneapolis.
For primary bibliographic entry see Field 6E.
W79-09457

MULTILEVEL APPROACH TO URBAN STORM WATER SYSTEMS PLANNING,
Purdue Univ., Lafayette, IN.
S. Dendrou.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-299 599, Price codes: A14 in paper copy, A01 in microfiche. PhD Dissertation. 1977. 283 p, 52 fig, 11 tab, 4 append. OWRT-B-083-IND(1).

Descriptors: *Urban drainage, *Urban land use, Drainage systems, Urban runoff, Storm drains, Storm runoff, Land use, Planning, City planning, *Urban growth, Urbanized watersheds, STORM, LANDUSE.

The study analyzes the relationship between urban growth and the storm drainage problem. A multilevel coordinating approach was used in a simulation-based optimization scheme that determines, at the planning level of details, the storm-water system best suited for a given trend of urban growth. The specific objectives were twofold: to select a land-use model producing independent urban growth alternatives and develop a model translating the alternatives into corresponding storm-drainage systems. The urban growth process was simulated by the use of the Model LANDUSE, a modified version of the 'Dynamic Land Use Allocation Model' of B. Walsh and S. Grava. The simulation model produced a number of independent plausible future scenarios of urban growth, the interfacing between urban growth model and storm drainage model being achieved by the notion of land-use categories. The urban hydrology model STORM was used at the subbasin level. For each urban growth scenario of LANDUSE, STORM produced the corresponding performance of a prespecified local storm drainage system. The requirements of the subbasins composing the urban agglomeration were then 'coordinated' to produce a globaly optimal storm-water system for a given urban growth pattern. (Wiersma--Purdue)
W79-09488

6B. Evaluation Process

ECONOMIC BENEFITS FROM INSTREAM FLOW IN A COLORADO MOUNTAIN STREAM,
Colorado State Univ., Fort Collins. Dept. of Economics.
J. T. Daubert, R. A. Young, and S. L. Gray.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-299 490, Price codes: A08 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Colorado State University, Completion Report No. 91, June 1979. 149 p, 6 fig, 24 tab, 69 ref, 4 append. OWRT A-035-COLO(1) and A-040-CO(1).

Descriptors: *Instream flow, Evaluation, *Recreation, Trout, Regression analysis, Water allocation, Cache la Poudre River(Colorado).

Water flowing in streams has value for various types of recreationists. Increasing instream flows from low levels may enhance the recreational experience for fishermen, white water enthusiasts and

shoreline recreationists. Increasing instream flows in arid and semi-arid conditions may be in conflict with established withdrawal uses for irrigation, industries and households. Instream flows have a public or collective good character, such that market prices are not observable. Estimating marginal values for instream flow which are commensurate with those for withdrawal uses presents well-known difficulties. Following recently developed techniques for estimating the value of public goods, an iterative bidding game was administered in 1978 to a sample of recreationists using a Colorado mountain stream, to determine their willingness to pay for alternative rates of flow. Regression techniques were applied and the results were used to estimate the marginal value of instream flows for each month of the recreation season. The statistical reliability of the estimates was more than adequate, indicating the technique is suitable for aiding in instream flow management decisions.
W79-09416

WETLAND VALUES: CONCEPTS AND METHODS FOR WETLANDS EVALUATION,
Institute for Water Resources (Army), Fort Belvoir, VA.
R. T. Reppert, W. Sigleo, E. Stakhiv, L. Messman, and C. Meyers.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A069 088, Price codes: A06 in paper copy, A01 in microfiche. Research Report No. 79-R1, February 1979. Supercedes Wetland Values-Interim Assessment and Evaluation Methodology. 116 p, 5 fig, 11 tab, 146 ref.

Descriptors: *Wetlands, *Analysis, *Evaluation, *Classification, Biological communities, Food chains, Ecosystems, Habitats, Sanctuaries, Shore protection, Groundwater recharge, Water quality, Hydrologic systems, Flood protection, Environmental effects, Coastal marshes.

Guidelines for the identification and evaluation of the physical, biological, and human use characteristics of wetlands are presented. These guidelines are primarily intended to serve as an operational guide for wetland studies made in conjunction with Corps of Engineers civil works activities and regulatory functions. Wetlands are defined and described. Basic functions and values covered are: natural biological functions including food chain productivity and habitat, usage as sanctuaries, shoreline protection, groundwater recharge, storage for flood and stream water, water quality improvement, hydrologic support, and cultural values. Specific criteria for determining the efficiency with which these functions are performed are identified. Wetland evaluation methods discussed include a non-quantitative method in which individual wetland areas are evaluated based on the deductive analysis of their individual functional characteristics, and a semi-quantitative method in which the relative values of two or more site alternatives are established through the mathematical rating summation of their functional relationships. An analysis of a hypothetical wetland is included. (Seigler-IPA)
W79-09433

FUTURE THINKING: FAD OR NECESSITY,
Institute for Water Resources (Army), Fort Belvoir, VA.
J. D. Priscoli.
Water Spectrum, Vol. 11, No. 2, p 9-15. Spring 1979. 5 fig.

Descriptors: *Water resources, *Water resources development, *Water supply, *Planning, Forecasting, Droughts, Political aspects, Administration, Floods, Federal government, Social aspects, Water supply.

The changing attitudes, problems and positions of water resources planners are discussed. The standard view of planning, that it is limited to factual consideration of means toward ends which are established outside of the planning process, is almost useless to field planners. Planning success is no longer measured by the traditional yardstick of new structures, but by the basic quality and availability of our water. Two views of water resources planning, scientific-administration and political-legislation, are considered. The current trend is away from making planners into politicians and toward making politicians, planners. The emerging role of water resources planners requires that they use their expertise to generate new options to meet changing social values rather than to rely on comfortable, timeworn solutions. Planners must also be managers which entails anticipating and mitigating conflicts, involving people, and facilitating concensus along the way. Failure to hone these skills as managers will increase planning and operating costs, decrease responsiveness to public needs, and weaken the nation. Thinking about the future is creating, designing, and expanding options. It is a management strategy as well as a 'scientific' analysis. (Seigler-IPA)
W79-09465

THE MOMENCE WETLANDS OF THE KANKAKEE RIVER IN ILLINOIS -- AN ASSESSMENT OF THEIR VALUE, A DESCRIPTIVE AND ECONOMIC APPROACH TO THE APPRAISAL OF NATURAL ECOSYSTEM FUNCTION,
W. J. Mitsch, M. D. Hutchinson, and G. A. Paulson.
Illinois Institute of Natural Resources, Chicago, Division of Environmental Management. Doc. No. 79/17, May 1979. 61 p, 13 fig, 5 tab, 53 ref, 2 append. 20.114.

Descriptors: *Wetlands, *Kankakee River(Illinois), *Land appraisals, Evaluation, Water quality, Wildlife management, Fisheries, Sediment control, Flood control, Groundwater recharge, Flood plains, Drought tolerance, Preservation, Forests.

Arguments for the preservation of the Momence Wetlands based on their actual and potential public service functions are presented. The area is a six-mile section of floodplain forest, marshes, sloughs, and upland forest from the Illinois - Indiana state line to Momence, Illinois. Although much of the area is privately owned, there is little evidence of man's activity and most of the area remains as it was in presettlement times. In spring, the river exceeds its bank, often for several weeks, submerging the bases of the floodplain trees. Valuable functions of the wetlands include: fish and wildlife protection, flood control, drought prevention, water quality enhancement, and sedimentation control. The wetlands also are of historic value as a significant remnant of our natural heritage. Two general approaches were used to determine the economic value of the natural areas of the Momence Wetlands. One approach, utilizing estimations of the cost of replacing ecosystem function by technology, placed a value of $494 per acre per year on the 1,899 acres of wetlands. The second approach, using the ecosystem energy flow as a collective measure of ecosystem function, placed a value of $289 per acre per year on the land. Although these estimates differ and are approximate, they both indicate that the wetlands are valuable in their natural state and should receive special preservation protection. (Seigler-IPA)
W79-09473

DOING SOCIAL EFFECTS ASSESSMENT: TWO CASES FROM A CORPS FIELD DISTRICT,
Army Engineer District, Portland, OR.
R. Love.
IWR Research Report 78-R4, November 1978. Final Report submitted to the U.S. Army Engineer Institute for Water Resources. 42 p, 3 fig, 3 tab, 8 ref, 2 append.

Descriptors: *Social effects assessment, *Social impact, Oregon, Applegate Dam, Days Creek Dam, Reservoirs, Relocation, Water quality, Recreation, Irrigation, Flood control, Land use, Economic impact, Condemnation value.

The methods used to conduct social effects assessments for two proposed Corps projects in southwest Oregon, Applegate and Days Creek dams, are described and discussed. Management and technical considerations involved in the assessments are described in a step-by-step historical presentation. The study is intended to complement the 'how to do social effects analysis' thrust of preceeding manuals. A summary of social effects include: (1) social settings, (2) effects of displacement on relocatees, (3) effects stemming from displacement of social institutions, (4) effects from reservoir recreation, (5) effects from irrigation, (6) effects from flood control, and (6) effects from water quality and low flow augmentation. Social profiles were developed on the people who would be affected by various aspects of the proposed reservoirs, especially those living relatively close to the projects. The interrelationship between social system, land use, and population factors served as a general conceptual scheme for the assessments. A sample of the questionnaire used when interviewing local people is included. (Seigler-IPA)
W79-09481

IMPACT OF DAM AND LAKE CONSTRUCTION ON RURAL ECONOMIES,
Corps of Engineers, Omaha, NE. Missouri River Div. Lab.
D. Gjesdahl, and W. Drake.
IWR Research Report No. 79-R4. Submitted to the U.S. Army Engineer Institute for Water Resources, April 1979. 29 p, 4 fig, 11 tab, 15 ref.

Descriptors: *Social impact, *Land use, *Economic impact, *Dams, *Lakes, Recreation, Population, Employment, Taxes, Planning, Land acquisition, Water resources development, Social aspects, Rural areas, Missouri, Kansas.

The economic impacts of five multipurpose dam and lake projects located in rural areas of Kansas and Missouri were assessed. Elements of land use, population and employment, and government and taxes were evaluated as indicators. The four projects in Kansas are Perry, Ponona, Tuttle Creek, and Milford. The fifth project, Pomme de Terre, is located in southwestern Missouri. Each of these projects has potential for considerable recreation development and each lake is between 30 and 150 miles of the Kansas City metropolitan area. The assessment time frame focused on three distinct phases of project land acquisition and development. There is little evidence that government land acquisition for the projects had a significant adverse effect on the economics of the project counties. Those people immediately touched by the acquisition of their land, however, undoubtly suffered acute economic disruption and probably faced considerable social adjustment. The projects introduced a new industry, recreation, to the counties. Large numbers of people have been attracted to the lakes. However, it is difficult to detect a significant economic contribution by the recreation industry to the local economy. Also, the lakes have stimulated relatively little capital investment. It is probable that the economic benefits are distributed throughout a large region and reach, especially into the metropolitan cities where recreation facility users live, work, and shop. (Seigler-IPA)
W79-09483

CHIEF JOSEPH DAM COLUMBIA RIVER, WASHINGTON: COMMUNITY IMPACT REPORT UPDATE III CONDITIONS AT PEAK IMPACT,
Army Engineer District, Seattle, WA. Seattle District.
A. A. Harnisch.
IWR Research Report No. 78-R2. Submitted to the Institute for Water Resources, December 1978. 68 p, 14 fig, 20 tab, 1 append.

Descriptors: *Chief Joseph Dam, *Social impact, *Economic impact, *Water resources development, Planning, Construction, Employment, Population, Public health, Columbia River, Schools, Housing, Recreation, Land use, Service impact, Water resources planning.

Peak construction social impacts at Chief Joseph Dam, Washington were compared to those projected in pre-construction phases. The dam is located on the Columbia River in north-central Washington near the small communities of Bridgeport and Brewster. The area is predominantly agri-

cultural, with scattered small rural towns. Agriculture is an important component of the economy, with irrigated fruit crops, beef cattle, and wheat as primary products. Areas of social and economic effects discussed include: population growth, housing, schools, health care facilities, traffic, noise, police protection, fire protection, utilities, esthetic values, civic organizations, and community growth. A profile was developed of a 'typical' construction worker that included: residency, prior employment, occupation, age, marital status, family size, and school age children. Results show an influx of about 1,000 new residents, the equivalent of a 50 percent population increase during a 2-year period. Quality and availability of housing were insufficient. Local schools received the major impact, and enrollments rapidly exceeded capacity. Sewer and water utilities also operated at or in excess of capacity. Aside from the crowded housing and schools, the local communities exhibited little physical change from preimpact conditions. Indications are that the towns will rapidly revert to preimpact population levels as dam construction is completed. (Seigler-IPA)
W79-09484

METHODOLOGIES FOR VALUATION OF AGRICULTURAL CROP YIELD CHANGES--A REVIEW,
Eureka Labs., Inc., Sacramento, CA.
S. Leung, W. Reed, S. Cauchois, and R. Howitt.
Publication No. EPA-600/5-78-018, August, 1978. 167 p, 5 fig, 3 tab, 433 ref.

Descriptors: *Crop production, *Economic impact, Economic prediction, Yield equations, *Model studies, Methodology, Reviews, Pollutants, Air pollution, Agriculture.

This research effort was initiated with the objective to complete a review and evaluation of the methodological and analytical techniques used to assess and quantify the economic impact of changes in agricultural crop yields. The review focused on two major areas: (1) physical effects of man-made and natural factors on agricultural crop yield, and (2) methodologies and models used to evaluate and quantify the economic impacts of crop yield changes on the farm, the agricultural industry and finally the consumers. The major natural environmental factors included in this report are climate and weather, soil and biological conditions. Air pollution was the main consideration under the man-made factors. Three alternative models were identified for the evaluation of the cost to an individual farm due to changes in crop yield. These models are (a) mathematical optimization model, (b) simulation model, and (c) econometric model. Also outlined were the regional input-output model and the regional spatial programming model as two feasible approaches in evaluating the secondary economic impacts. Finally, the market supply and demand theories were identified as relevant concepts in analyzing the overall impacts on consumers due to crop yield changes. (Skogerboe-Colorado State)
W79-09489

6D. Water Demand

PLANNING WATER USE AND QUALITY CONTROL IN A RIVER BASIN,
Akademiya Nauk SSSR, Moscow.
For primary bibliographic entry see Field 6A.
W79-09436

6E. Water Law and Institutions

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOL. II. BASIN PLAN APPENDIX,
Texas Governor's Planning Committee.
For primary bibliographic entry see Field 5F.
W79-09332

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME IV. INSTITUTIONAL ARRANGEMENTS,
Texas Governor's Planning Committee.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 847, Price codes: A04 in paper copy, A01 in microfiche. U.S. Army Corps of Engineers, Fort Worth District, September 1973, 55 p, 3 append.

Descriptors: *Water quality, *Water resources, *Waste water treatment, *Planning, *Colorado River Basin(TX), *Institutions, *Texas, Sewage districts, Water districts, Water management, Administrative agencies, Waste water facilities, Institutional constraints, Water quality management(Applied), State planning, Regional planning.

The objective of this study is the development of the most cost-effective strategy to meet stream water criteria for the 50-year planning period 1970-2020. The primary purpose of this phase was the development of institutional arrangements for the design, construction operation and maintenance of recommended system(s). Base data were gathered by questionnaire, interviews, telephone calls, and research. Existing institutions involved in water pollution control are described. Municipalities are more involved in water pollution abatement than any other institution. There are approximately 79 treatment plants in the Basin, generally owned by the municipality in which they are located. Location, design load, and current and projected populations for the regional planning area of each plant are presented. Five alternative institutional arrangements which could implement a wastewater management plan are described. Under existing Texas law, the Texas Water Quality Board (TWQB) has the overall authority in the implementation of institutional arrangements. The favorable and unfavorable impacts of each of the five alternative implementation plans are presented. Institutional arrangements are discussed and evaluated. Alternative 1 is recommended as the most favorable for implementation of this study--the TWQB coordinating implementation functions directly with municipalities and other public entities. (See also W79-09331) (Coan-NC)
W79-09334

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME V. UPPER BASIN,
Texas Governor's Planning Committee.
For primary bibliographic entry see Field 5D.
W79-09335

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME VI. CENTRAL BASIN,
Texas Governor's Planning Committee.
For primary bibliographic entry see Field 5D.
W79-09336

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME VII. LOWER BASIN,
Texas Governor's Planning Committee.
For primary bibliographic entry see Field 5D.
W79-09337

THE TASK OF RELATING THE LOCAL GOVERNMENT COMPREHENSIVE PLAN OF PALM BAY TO THE OTHER PLANS OF THE STATE,
G. S. Fortin.
Available from Eastern Water Law Center, University of Florida, Gainesville, Florida 32611. $0.80. 1978, 20 p, 45 ref.

Descriptors: *Local governments, *Florida, *Land management, *Comprehensive planning, Land development, Water storage, Water management, Water districts, Water pollution control, Water zoning, Watershed management.

The intergovernmental consistency of the Local Government Comprehensive Plan for Palm Bay, Florida as related to the Local Government Comprehensive Plans of the surrounding local governments is explored. The focus is on the problems inherent in the making of a plan, due to both the individual problems of Palm Bay, and those inherent in the Local Government Comprehensive Planning Act (LGCPA). Discussed are the Melbourne Tillman Drainage District Revised Plan of Reclamation, the Brevard County Land Use Plan, Phase I Plan of the St. Johns River Water Management District, the Coastal Zone Management Plan proposal, and the Florida State Comprehensive Plan submitted February 9, 1978. A Comprehensive plan is mandated by the Local Government Comprehensive Planning Act (LGPCA). The legislative intent was that there be cooperation and coordination of planning and development through comprehensive planning. Some of the problems encountered in attempting to meet this goal are discussed. (Coffey-Florida)
W79-09442

CONSTRUCTION AND APPLICATION OF GEOTHERMAL STEAM ACT OF 1970, PERTAINING TO LEASES OF GOVERNMENT LANDS FOR DEVELOPMENT OF GEOTHERMAL STEAM RESOURCES,
E. R. Alston.
40 A.L.R. Fed. 814-20 (1978).

Descriptors: *Steam, *Resources development, *Public lands, *Leases, Federal government, Federal jurisdiction, Energy budget, Electric generators, Electricity, Water policy, Water law.

The federal cases are collected and analyzed wherein the courts have construed or applied the provisions of the 1970 Geothermal Steam Act (Act). The Act provides for the development, production, and utilization of geothermal steam and associated resources on public lands as a commercially viable energy source. Geothermal energy is defined as the earth's heat energy produced by the intrusion of magma or molten rock into the earth's crust, heating porous rocks containing water to temperatures as high as 500 degrees F. This superheated water rises to the earth's surface through natural vents as steam, which may be used to generate electricity. In recommending passage of the Act, the Committee on Interior and Insular Affairs stated that geothermal energy is a potentially invaluable untapped natural resource, and that geothermal resources promise to be a relatively pollution-free energy source. The Act's provisions regarding the terms and conditions of geothermal leases, not construed by reported cases, are also discussed. (Coffey-Florida)
W79-09443

CARTER'S WATER POLICY TO GET CONGRESSIONAL TEST,
A. Pelham.
Congressional Quarterly Weekly Report, Vol. 36, No. 23, p 1491-94, June 10, 1978.

Descriptors: *Water policy, *Federal government, *Political constraints, *Political aspects, Federal budget, Dams, Water conservation, State governments, Economic justification, Groundwater, Water management, Water law.

In June, 1978 President Carter announced a national water policy designed to tighten Administrative control over federal spending for expensive dams and other water projects. An analysis of Carter's policy proposals is presented. The administration's proposals placed new emphasis on water conservation as a national goal and more state participation in the planning and funding of water projects. Future authorizations for projects would have to meet tougher criteria for enhancing conservation providing national economic benefits and protecting the environment. A new review panel would provide an independent uniform analysis of all federal water projects. This report would be available to the public. Carter did not seek legislation to raise the interest rate used to compute project benefits and costs despite complaints that the rate is artificially low and tends to favor the construction of projects. Little incentive is provided for better groundwater management by western states. (Coffey-Florida)

W79-09444

HOUSE VOTES AMENDED CONTINENTAL SHELF BILL,
A. Pelham.
Congressional Quarterly Weekly Report, Vol. 36, No. 3, p 251-54, February 4, 1978.

Descriptors: *Oil pollution, *Continental shelf, *Political aspects, *Federal government, Political constraints, Oil, Oil industry, Oil spills, Offshore platforms, Leases, Water policy.

After accepting a hodgepole of amendments that calmed many critics, the United States House of Representatives voted to amend the law that since 1953 has governed oil and gas development on the Outer Continental Shelf (OCS). A detailed analysis of the political aspects of obtaining legislation on drilling for oil on the OCS is presented. The alternative bidding systems instituted by Congress and how the compromise was finally reached are explained. The House committee was bill authorized grants of $125 million annually through fiscal 1984 to the coastal states to handle problems with OCS related activity. Other amendments adopted by the House included: (1) deleting the provision which expanded the authority of the Occupational Health and Safet Administration over OCS activities; (2) increasing the maximum payment from the Fisherman's Gear Compensation Fund; (3) authorizing $5 million in annual grants to states for costs associated with their increased role in federal decisions on offshore leasing; and (4) changing the position of a lease-holder seeking compensation for a cancelled lease. Also reported are the suggested amendments that failed. (Coffey-Florida)
W79-09445

CONGRESS OVERHAULS CONTINENTAL SHELF LAWS,
A. Pelham.
Congressional Quarterly Weekly Report, Vol. 36, No. 34, p 2253-55, August 26, 1978.

Descriptors: *Continental shelf, *Offshore platforms, *Federal government, *Oil pollution, Oil, Oil industry, Environmental control, Leases, State government, Oil spills, Oil reservoirs, Water policy.

The first overhaul of offshore oil and gas leasing laws in 25 years is expected to be signed by President Carter in early September, 1978. The long-sought changes were given final approval by Congress after almost four years of debate. Although Congress had faced bitter opposition, the latest compromise was generally accepted by most major oil companies, environmentalists and the Carter administration. Many of the modifications and amendments to the 1953 Outer Continental Shelf Lands Act are discussed: (1) development of a Comprehensive five-year program for Outer Continental Shelf leasing; (2) solicitation of recommendations regarding the leasing program from governors of effected states; (3) an environmental study of each general area proposed for leasing; (4) review study of safety regulations; (5) permission to effected persons to challenge any Act violation in court; (6) setting of civil penalties of up to $10,000 per day for failure to comply with the Act; (7) submission of a required development and production plan for all future leases; and (8) a review of the development plants by the Secretary of the Interior. (Coffey-Florida)
W79-09446

WETLANDS AND FLOODPLAIN PROTECTION,
G. McGregor, and A. Dawson.
Massachusetts Law Review, Vol. 64, No. 2, p 73-80, April 1979.

Descriptors: *Wetlands, *Flood plains, *Massachusetts, *Flood protection, Federal government, State government, Local governments, Water policy, Water pollution, Flood control, Navigation, Groundwater.

Many federal, state, and local bylaws, regulations and statutes regulate development in water bodies, waterways, associated wetlands and areas prone to flooding. Principal interests protected are flood control, water supply, groundwater, navigation, the natural food chain, prevention of storm drainage and pollution, and protection of fish and shellfish. These controls effect developers, landowners, financial institutions, contractors, municipalities, abutters, agencies and public interest groups. The attorney representing such clients is commonly confronted with two problems: (1) how to know when a wetland issue arises and what regulatory controls are likely to apply, and (2) how to predict accurately the jurisdiction, the likely agency concerns and avoid procedural stumbling blocks. The federal, state and local wetland and floodplain protection programs of which the attorney should be aware are surveyed. The ways in which the practioner will confront legal provisions affecting clients and the ways to foster an understanding of the basic agency procedures and the public interests involved are illustrated. (Coffey-Florida)
W79-09447

CARTER'S WATER POLICY REFORMS - TRYING NOT TO MAKE WAVES,
D. Kirschten.
National Journal, Vol. 11, No.10, p 394-97, March 10, 1979.

Descriptors: *Water policy, *Federal project policy, *US Water Resources Council, *Federal budget, Federal government, Political aspects, Political constraints, Financing, Financial feasibility, Administration, Administrative decisions.

After a bruising battle over water projects in the last Congressional Session, the Carter Administration has decided to push its water policy reforms more cautiously. A detailed analysis of the many reforms suggested by the Carter administration and the political constraints those reforms encountered are presented. President Carter now appears to be charting a safer course through the 96th Congress. His fiscal 1980 budget proposals have drawn fire from both reformers and defenders of the status quo - a sign that his proposals are somewhere near middle ground. The Administration is stressing the importance of accepting some past congressional decisions not to the Administration's liking, rather than resurrecting those battles already lost. The Administration has three immediate objectives in this Congressional session: (1) a defense of their 1980 water projects budget; (2) passage of a state-federal cost-sharing bill designed to give the states some leverage in the selection of projects; and (3) a quick infusion of funds for the Water Resources Council that will set new project standards, review construction decisions and administer grant programs to promote state water conservation and planning efforts. (Coffey-Florida)
W79-09448

CUTTING FUTURE LOSSES: DROUGHT SPURS FEDERAL WATER POLICY REVIEW,
J. Wagner.
Congressional Quarterly Weekly Report, Vol. 35, No. 41, p 2139-42, October 8, 1977.

Descriptors: *Droughts, *Federal project policy, *Water supply development, Water conservation, Water demand, Water levels, Water shortage, Water requirements, Water supply, Aqueducts, Water policy.

Although the drought of 1977 threatened essential food crops, forced water conservation measures and set off federal spending of approximately $2-billion, it has not been quite the disaster predicted. Several federal agencies provided emergency grants and loans to ease the drought's effects. A nation-wide disaster may have been averted, but the drought has focused attention on programs that bring relief but no protection. Federal officials are emphasizing planning for droughts and wiser land use in dry areas. Much of the federal effort in the past has gone into constructing gigantic water projects which have fostered the ideas that water is a boundless resource and that enough dams and aqueducts will prevent drought. In 1977, those ideas were disproven. The Administration's emergency program and all the additional funds now going to drought relief are short-term measures. They can mitigate some effects of drought but they do not get to the basic issue of water policy reform. The Carter administration has begun a review of federal water policy that is expected to propose new criteria for building and managing reclamation projects. (Coffey-Florida)
W79-09449

WATER POLLUTION COMPROMISE CLEARED,
A. Pelham.
Congressional Quarterly Weekly Report, Vol. 35, No. 52, p 2666-75, December 24, 1977.

Descriptors: *Water pollution, *Federal water pollution control act, *Political aspects, *Water pollution treatment, Economic feasibility, Economic impact, Environmental effects, Industries, Administrative agencies, Water policy, Political constraints, Economic justification.

The amendments in the 1977 Clean Water Act (CWA) kept intact the basic principles of the strong 1972 Federal Water Pollution Control Act (FWPCA) though some clean up delays were allowed on economic grounds. The changes made by the CWA were touted as only mid-course corrections, when Congress began tinkering with the FWPCA. Industry had hoped for a major rewrite. Environmentalists had feared a damaging postponement of the FWPCA's goals. Ultimately, the final compromises left no clear victor. Industry spokemen hailed the bill as a step towards reasonableness in pollution control but admitted some disappointments. Environmental groups were split. Some joined the federal Environmental Protection Agency (EPA) officials in praising the conferees. Others insisted the legislation was a step backwards. The amendments provide the EPA administrator with new flexibility, make control of toxic chemicals top priority, and provide major funding for the nation's sewage treatment construction program. An indepth analysis of these amendments and background information are provided. (Coffey-Florida)
W79-09450

CHATTAHOOCHEE RIVER NATIONAL RECREATION AREA - GEORGIA - ESTABLISHMENT.
Public Law 95-344, secs 101 thru 306, 92 Stat. 474 (1978).

Descriptors: *Georgia, *Chattachoochee River, *National recreation areas, *Recreation facilities, Federal government, Recreation, Protection, Preservation, Public benefits, Public lands, Public access, Rivers.

The Congress has found the natural, scenic, recreation, historic, and other values of a forty-eight mile segment of the Chattahoochee River and certain adjoining lands from Buford Dam downstream to Peachtree Creek are of special national significance. Such values should be preserved and protected from development and uses which would substantially impair or destroy them. To assure such preservation and protection the Chattahoochee River National Recreation Area was established. The recreation area shall consist of the river and its bed plus lands, waters, and interests within the boundary depicted on the Chattahoochee River National Recreation Area map, numbered CHAT-20,000, on file in the office of the National Park Service, Department of the Interior. The Secretary of the Interior is authorized to make minor revisions in the recreation area boundary to facilitate access to the recreation area or to delete lands which would be of little or no benefit to the area. Lands of no benefit are those on which valuable improvements have been completely constructed prior to this Act's enactment. (Coffey-Florida)
W79-09451

COAL MINING POINT SOURCE CATEGORY EFFLUENT GUIDELINES AND STANDARDS.
Environmental Protection Agency, Washington, DC.

Federal Register, Vol. 44, No. 9, p 2586-92, January 12, 1979.

Descriptors: *Coal mines, *Coal mine wastes, *Navigable waters, Federal water pollution control act, Federal government, Water law, Water policy, Pollution abatement, Political constraints, Regulations.

On September 19, 1977, the Environmental Protection Agency (EPA) proposed regulations setting forth limitations on the pollutant discharge into navigable waters from new source coal mines and coal preparation plants, as required by the Federal Water Pollution Control Act. The rules here promulgated establish final performance standards for new sources in the coal mining point source category. Changes and clarifications in response to comments received on the proposed regulations are included. These performance standards will be incorporated in National Pollutant Discharge Elimination Systems permits issued by EPA or by states with approved programs. The regulations incorporate several adjustments to the proposed standards of performance. These changes reflect EPA's consideration of the substantial number of comments received from industrial and environmental groups. The comments are addressed in detail in Appendix A to the preamble. The effective date is February 19, 1979. (Coffey-Florida)
W79-09452

OUTER CONTINENTAL SHELF LANDS ACT AMENDMENTS OF 1978.
Public Law 95-372 (S.9), secs 101 thru 608, 92 Stat. 629 (1978).

Descriptors: *Continental shelf, *Oil fields, *Resources development, Natural gas, Pollution abatement, Oil wastes, Oil pollution, Oil, Oil wells, Oil reservoirs, Federal government.

The purposes of this Act are to: (1) establish policies and procedures for managing the oil and natural gas resources of the Outer Continental Shelf (Shelf); (2) preserve, protect, and develop oil and natural gas resources in the Shelf consistent with the nation's energy needs while protecting the human, marine, and coastal environments; (3) ensure the public a fair return on the Shelf's resources while preserving free enterprise competition; (4) encourage development of new and improved technology to eliminate or minimize risk of damage to the environment; (5) provide assistance to states and local governments to deal with the impact of Shelf oil and gas activities; (6) assure participation of state and local governments in planning and policy decisions relating to Shelf resource management; (7) minimize or eliminate conflicts between oil and gas production and the recovery of other resources, such as fish and shellfish; (8) establish an oilspill liability fund; and (9) establish a fishermen's contingency fund to pay for damages to commercial fishing vessels and gear due to Shelf activities. (Coffey-Florida)
W79-09453

OCEAN THERMAL ENERGY CONVERSION (OTEC) DEVELOPMENT UNDER U.S. AND INTERNATIONAL LAW AND INSTITUTIONS,
Denver Univ., CO.
V. P. Nanda.
Denver Journal of International Law and Policy, Vol. 8, No. 1, p 239-88, Winter, 1979.

Descriptors: *Thermal water, *Thermal powerplants, *Energy conversion, Energy, Energy transfer, Law of the sea, Conferences, Jurisdiction, Regulation, Environmental effects, Oceans.

Ocean thermal energy conversion (OTEC) is a viable alternative in the near future. Although economic and technological issues have not been settled, the legal aspects must be considered. Jurisdictional, regulatory, and environmental issues are addressed. Emphasis is placed on the potential impact of the Third United Nations Conference on the Law of the Sea. On the jurisdictional issues, the United States should seek freedom in OTEC siting and development. From a domestic perspective, there are valid reasons for state or federal control of OTEC facilities. Development of regulatory schemes should provide certainty for prospective investors. An inflexible or cumbersome regulatory scheme must be avoided. Potential environmental impacts from OTEC facilities include those from construction and operation of such facilities, cables and transmission lines, and onshore services and support facilities. Domestic legislation relevant to OTEC is discussed. These include the Outer Continental Shelf Lands Act and the 1969 National Environmental Policy Act. Comprehensive ocean management legislation is needed for the United States. Internationally, a convention which mandates environmental impact assessments of any state's major projects should be considered. (Walker-Florida)
W79-09454

THE POLITICS OF MANGANESE NODULES: INTERNATIONAL CONSIDERATION AND DOMESTIC LEGISLATION,
Committee on Merchant Marine and Fisheries (U. S. House).
J. Murphy.
San Diego Law Review, Vol. 16, No. 3, p 531-55, April 1979.

Descriptors: *Political aspects, *Manganese, *International law, *United Nations, Legislation, Political constraints, Legal review, Mining, Law of the sea, Economic justification, Economic feasibility.

The legal regime governing the recovery of deep seabed minerals may be the most difficult issue now confronting the United Nations Conference on the Law of the Sea. Congressman John M. Murphy discusses unilateral legislation. Such legislation would be fully consonant with prevailing international law and would spur on the negotiations of the Conference. The various economic, legal, and political considerations involved in the recovery of deep seabed minerals and the problems associated with the United Nations Conference on the Law of the Sea are outlined. The Deep Seabed Mining bill is analyzed in the context of the international legal system and the Law of the Sea Conference. The United States should enact the bill so that exploration and commercial recovery may proceed. Legislation of the type Congressman Murphy proposes will have a positive economic impact on the entire world, will encourage the technological advances, and will persuade the negotiating states to begin good faith bargaining. (Coffey-Florida)
W79-09455

THE OUTER CONTINENTAL SHELF: BRIDGING THE INFORMATION GAP THROUGH REGULATION,
S. A. Shafer.
Arizona State Law Journal, Vol. 1978, No. 4, p 617-40, 1978.

Descriptors: *Continental shelf, *Oil wells, *Leases, Political aspects, Resources development, Environment, Environmental effects, Energy, Geographical regions, Decision making, Legislation.

Oil and gas reserves beneath the waters of the Outer Continental Shelf (OCS) are important for meeting the current and future energy needs of the United States. Two types of information are needed for rational decision-making concerning OCS development. First, exploratory information is needed to assess the extent of OCS oil and gas reserves. Second, environmental information is needed to determine the potential harmful effects of OCS development. The Outer Continental Shelf Lands Act (OCLA) gave the Secretary of Interior the authority to lease lands on the OCS for oil, gas, and mineral production. The 1978 Amendments to the OCSLA provide that the OCS leasing programs are to be guided by four primary policy goals: (1) rapid development of OCS oil and gas reserves; (2) protection of the environment; (3) realization of a fair return to the government; and (4) assurance of free competition among firms bidding for OCS leases. The OCSLA and other federal laws seek to ensure that OCS leasing decisions are not made without sufficient knowledge of the potential benefits and risks. (Fortin-Florida)
W79-09456

A PHANTOM DOCTRINE: THE ORIGINS AND EFFECTS OF JUST V. MARINETTE COUNTY (CONTROL OF LAKE SHORE EROSION THROUGH FILL PERMITS),
Minnesota Univ., Minneapolis.
D. P. Bryden.
American Bar Foundation Research Journal, 1978 Volume, No. 3, p 497-513, Summer, 1978.

Descriptors: *Zoning, *Land use, *Marsh management, Marshes, Planning, Local governments, Land management, Landfills, Environmental control, Regulation, Permits.

In testing the constitutional limits of the police power in zoning regulation, the main issue is how severely the government may reduce the value of land without compensating the owner. Recently, state and local governments have sought to preserve the landscape by novel and sometimes stringent land use controls. Some scholars have suggested abandoning the 'diminution-of-value' test for determining a regulation's constitutionality. In Just v. Marinette County, the Wisconsin Supreme Court declared that shoreland marsh development may be forbidden irrespective of the economic impact on the landowner. Such decisions create the impression that property owners are being sacrificed for the sake of environmental quality. But a study of Just's origins and effects reveals that in Wisconsin and Minnesota this impression of regulatory zeal is inaccurate. The main concern of the counties studied was not to preserve marshes but rather to attach erosion-control conditions to fill permits. It appears that ideology and politics, not constitutional law, are the major factors limiting the severity of conservancy zoning. (Fortin-Florida)
W79-09457

EXTENDED FISHERY JURISDICTION IN CANADA AND THE UNITED STATES,
West Coast Oil Ports Inquiry, Vancouver (British Columbia).
R. Snow.
Ocean Development and International Law, Vol. 5, No. 2/3, p 291-344, 1978.

Descriptors: *Canada, *United States, *Jurisdiction, *Fish management, Fisheries, Fish conservation, Fish harvest, Water law, Fish populations, Food abundance, Recreation.

The two hundred mile fishery zone presents opportunities for coastal states to create new institutions or pursue new management strategies. The strategies followed by the United States and by Canada in the initial stages of their extended jurisdiction management programs are discussed in sociolegal and historical contexts. The domestic legal authority for the management programs is reviewed. Planning procedures and available sanctions are outlined. The control of domestic and foreign fishing is discussed. There should be greater participation in the development of fishery management plans. A possible system for implementation is suggested. The American management system is open, decentralized, and highly structured. In contrast, the Canadian system is closed, relatively centralized, and very flexible. Both approaches are considered extreme. There is no evidence of the development of new procedures for management decision making. (Coffey-Florida)
W79-09458

THE CLEAN WATER ACT OF 1977: EXPANDED COMPETENCE OVER VESSEL-SOURCE POLLUTION,
Virginia Univ., Charlottesville.
R. R. Pixa.
Virginia Journal of International Law, Vol. 18, No. 2, p 289-317, 1978.

Descriptors: *Federal water pollution control act, *Water pollution control, *Water pollution sources, *Oceans, Water quality act, Pollution abatement, Legislation, Environmental controls, Conservation, Juridiction, Water law.

The law governing vessel-source pollution is an accretion of provisions in Title 33 of the United States Code, built upon the Federal Water Pollution Control Act, the 1970 Water Quality Improvement Act, and the 1972 Federal Water Pollution Control Act. The Clean Water Act raises four principal issues concerning vessel-source pollution: (1) the size of the area over which competence is claimed; (2) the duties of vessels within that area; (3) the liability to be imposed upon those vessels; and (4) the enforcement scheme to be employed. The pollution control scheme in force is limited over foreign-flag vessels, not otherwise under United States jurisdiction, navigating within a loosely defined area from 12 to at least 200 miles seaward from U.S. coasts. The scheme includes penalties for discharges of harmful quantities of nonremovable hazardous substances and for government costs. It also attempts to impose a duty to give notice of illegal discharges but has no enforcement provisions. Because the Clean Water Act has not yet been enforced, it is a devise of undetermined power. (Fortin-Florida)
W79-09459

THE COMMON HERITAGE OF MANKIND: HAS THE GENERAL ASSEMBLY CREATED A LAW TO GOVERN SEABED MINING,
P. L. Saffo.
Tulane Law Review, Vol. 53, No. 2, p 492-520, February, 1979.

Descriptors: *Law of the sea, *United Nations, *Resources development, *International law, International waters, Deep water, Mining, Mineral industry, Conferences, Jurisdiction, Resources.

Committee I at the United Nations Conference on the Law of the Sea is deadlocked on the procedure which should be employed to control the mining of the deep seabed. The less developed nations desire an International Seabed Authority to gather technology and establish a monopoly, so that multinational corporations could be phased out of the mining process. The developed nations want minimum administrative encumbrances. Should the Conference fail to establish guidelines, the mining will proceed under customary international law. Three potential approaches are proposed that a nation can adopt to mine the seabed under international law: (1) a state may authorize nonexclusive mineral collection operations. This approach is feasible but mining concerns will not accept its inherent instability; (2) a state may assume general resource sovereignty over a seabed area. This is clearly unacceptable in view of the 1958 Continental Shelf Convention; and (3) a state may exercise a specific resource sovereignty over a seabed area. No concise conclusion is drawn on this proposal although it is possible despite the difficulties of implementation. The effect of United Nations resolutions on each of these proposals is discussed. Proposition one is most widely accepted. (Walker-Florida)
W79-09460

THE GROUP OF 77 AT THE UNITED NATIONS: AN EMERGENT FORCE IN THE LAW OF THE SEA,
Assistant Secretary of Defense (International Security Affairs), Washington, DC.
A. Friedman, and C. Williams.
San Diego Law Review, Vol. 16, No. 3, p 555-575, April 1979.

Descriptors: *United Nations, *Law of the sea, *International law, *Political aspects, International waters, Political constraints, Water policy, Africa, Coasts, Water law.

The politics of a bloc of nations known as the Group of 77 (Group) is studied. The countries that comprise this bloc are variously referred to as 'less-developed countries', 'Third World Countries,' 'developing countries,' or 'underdeveloped countries.' A brief history of the Group's diplomacy in United Nations and the Group's role within the Law of the Sea Conference is detailed. Through illustrations of the Group's bloc-policy process, a model is constructed to explain the Group's behavior. The internal processes of the Group are explored, through an observational analysis of international group dynamics in a lawmaking context. The Group's unity is now less certain because of the many cross-cutting interests at stake in the Third United Nation Conference on the Law of the Sea. Western intransigence is cited as a unifying force for the Group under the 'common enemy' principle. (Coffey-Florida)
W79-09461

SYNOPSIS: RECENT DEVELOPMENTS IN THE LAW OF THE SEA 1977-1978,
R. Siref.
San Diego Law Review, Vol. 16, No. 3, p 705-733, April, 1979.

Descriptors: *Law of the sea, *United Nations, *International law, Water law, Political aspects, Political constraints, Mining, Fishing, Panama canal, Antarctic, Oil pollution.

The major events that occurred in the Law of the Sea between March 1977 and December, 1978 are surveyed. The Sixth and Seventh Sessions of the Third United Nations Conference on the Law of the Sea (UNCLOS III) are discussed at length. Other significant events discussed include: (1) United State Congressional legislation on the deep seabed mining question; (2) states unilateral extension of sovereignty over fishing waters; (3) the Panama Canal Treaty; (4) the Antarctic treaty states meeting to determine the future of Antarctica; (5) the Intergovernmental Maritime Consultative Organization's agreement on Oil Tanker Pollution Control; (6) the Mediterranean States' failure to agree on a comprehensive plan to prevent pollution of the Mediterranean; and (7) step taken to preserve the ocean's whales. Although many significant events occurred between March, 1977 and December 1978, in the Law of the Sea, UNCLOS continues to dominate events with attempts to develop a plan to govern the world's oceans. (Coffey-Florida)
W79-09462

CONDITION AND OPERATION STUDIES -- RECREATION: SECTION I: EVALUATION OF OPERATIONAL EFFECTIVENESS OF RECREATION SITES. SECTION II: INVESTMENT ANALYSIS OF RECREATION FACILITY DEVELOPMENT,
Army Engineer District, Sacramento, CA.
R. E. Brown, and W. J. Hansen.
IWR Research Report No. 78-R3, November 1978. Submitted to the U.S. Army Engineer Institute for Water Resources. 42 p, 2 fig, 26 tab, 20 ref, 2 append.

Descriptors: *Recreation facilities, *Recreation demand, *Investment, *Economic efficiency, Planning, Value engineering, Reservoir operation, Camping, Swimming, Water sports, Boat-launching ramps, Fishing, Multiple-purpose projects, Tourism, Use rates, Operation and maintenance, Management.

On-site sample surveys of visitor preferences, expectations, satisfactions, and dissatisfactions were taken at park and recreation areas on nine lakes during June through September 1972. Park managers were also interviewed to determine their judgement of the effectiveness of their own areas. A sample of the questionnaire used is included. Results show: (1) the correlation between manager expectation of visitor responses and the actual responses were poor; (2) lowest ranked facilities and services include swimming areas, restrooms, showers, and concession stands without food service and public telephones; (3) highest ranked facilities and services include roads, signs and information services, parking, water supply, camp grounds, boating accommodations, and concessions providing boat rental and food services; and (4) administrative procedures are needed for declaring old, poorly utilized, and nonserviceable facilities to be defunct. The cost-effectiveness of several recreational sites with respect to operation and maintenance costs were also analyzed. Economic efficiency appears to be an obvious but seldom used criterion for determining what kind and how many facilities should be included at a site. Investment analysis, benefits, and costs and management decisions are discussed. (Seigler-IPA)
W79-09472

POTENTIAL EFFECTS OF ENVIRONMENTAL POLICIES ON RESOURCE USE AND REGIONAL INCOMES IN AGRICULTURE,
Iowa State Univ., Ames.
G. F. Vocke, and E. O. Heady.
Agriculture and Environment, Vol. 4, No. 2, p 99-109, August, 1978. 1 fig, 6 tab, 8 ref.

Descriptors: Agriculture, *Crop production, *Economics, Environment, Fertilizers, Land management, *Land resources, Land use.

The results of this study indicate that U.S. agriculture can comply with restrictive environmental policies but not without significant consequences for farmers and their incomes. The imposition of a soil conservation policy alters crop production patterns, changes the regional distribution of agricultural incomes, and implies higher food expenses for consumers. A restriction on the use of nitrogen fertilizer requires substantial substitutes of other resources to maintain agricultural output. However, regional production patterns are altered, thus changing regional incomes from agriculture. A ban on the use of the organochlorine insecticides Chlordane and Heptachlor causes few major changes for agriculture but there is the potential that the incomes of some Midwest corn farmers may be drastically reduced by an insect infestation. Requiring feedlot operators to control the runoff from their feedlots will be particularly costly for small livestock producers but does not significantly alter regional livestock production patterns. Under high exports which are not restrained by environmental measures, land used for crops increases by 67 million acres, fertilizer use increases by 29 percent, and pesticide expenditures increase by 50 percent. When the several environmental restrictions are applied simultaneously, the value of exports must decline by 40 percent. Accompanying the reduction in exports is a 60 percent decline in soil erosion and a 30 percent reduction in nitrogen use. (Skogerboe-Colorado State)
W79-09505

6F. Nonstructural Alternatives

WASTEWATER MANAGEMENT PLAN, COLORADO RIVER AND TRIBUTARIES, TEXAS. VOLUME I. BASIN PLAN,
Texas Governor's Planning Committee.
For primary bibliographic entry see Field 5F.
W79-09331

A PHANTOM DOCTRINE: THE ORIGINS AND EFFECTS OF JUST V. MARINETTE COUNTY (CONTROL OF LAKE SHORE EROSION THROUGH FILL PERMITS),
Minnesota Univ., Minneapolis.
For primary bibliographic entry see Field 6E.
W79-09457

6G. Ecologic Impact Of Water Development

DIVE STUDIES AT TWIN LAKES, COLORADO, 1974-75,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
J. F. LaBounty, R. A. Crysdale, and D. W. Eller.
Report No. REC-ERC-76-15, September 1976. 29 p, 27 fig, 4 tab, 5 ref, 1 append.

Descriptors: *Twin Lakes, *Colorado, *Mt Elbert pumped-storage powerplant, *Environmental effects, *Limnology, Pumped storage, Scuba diving, Lakes, Reservoirs, Aquatic habitats, Aquatic life, Lake trout, Shrimp, Aquatic plants.

Three separate SCUBA (Self-Contained Underwater Breathing Apparatus) dives were made at Twin Lakes, Colorado, to obtain a qualitative perspective of the aquatic environments of the lakes.

This data, combined with existing quantitative data, will provide a comprehensive base of ecological information on the lakes. The lakes are being enlarged to serve as the powerplant afterbay for the Mt. Elbert Pumped-Storage Powerplant. The plants pumpback capability and generation mode have the potential to substantially modify the aquatic ecosystem. Qualitative data are in the form of plant and animal observations, underwater photography, aquatic plant identification, and descriptions of bottom characteristics. Results show that both lakes contain numerous rocks ideal for lake trout spawning areas. Mysis shrimp were observed in both lakes with a high density near the powerplant tailrace. Fish observed include lake trout, suckers, rainbow trout, and smelt. Lake bottoms were found to be rocks and gravel interspersed with vegetation in shallow areas and easily disturbed glacial flour in the deep flat bottom areas. Details of diving methods are provided to illustrate the use of SCUBA diving in ecological studies of high altitude lakes. (Seigler-IPA)
W79-09424

HABITAT EVALUATION,
Fish and Wildlife Service, Fort Collins, CO.
M. Schamberger.
Water Spectrum, Vol. 11, No. 2, p 26-34, Spring 1979. 9 fig.

Descriptors: *Habitats, *Wildlife habitats, *Developed waters, *Water resources development, Recreation facilities, Fish management, Environmental effects, Preservation, Reservoirs, Habitat Evaluation Procedures, Mitigation, Birds, Habitat productivity.

Habitat Evaluation Procedures (HEP), a methodology designed to provide an objective and quantitative estimate of the 'value' of fish and wildlife resources, is discussed. Environmental protection is an important aspect of all water-related planning management decisions. One of the greatest problems associated with the protection of fish and wildlife is the difficulty of quantifying their value. The traditional methodology, 'man-day of use' considers neither the quality of the resource nor the amount of resource available, and can result in a distorted picture of the actual impact to fish and wildlife that results from project implementation. The HEP was designed to overcome the problems associated with the man-day of use approach on the habitat and its associated productivity. The HEP can be used at all stages of resource project planning. They provide a standardized data base to assess impacts on fish and wildlife for the evaluation of alternate project sites and plans to determine what measures, if any, are needed for mitigation and/or compensation. The greatest value of the HEP is their application and usefulness throughout the planning process. (Seigler-IPA)
W79-09467

7. RESOURCES DATA

7B. Data Acquisition

SYMPOSIUM ON THE PHYSICS AND CHEMISTRY OF ICE,
For primary bibliographic entry see Field 2C.
W79-09342

DIELECTRIC PERMITTIVITY OF GLACIER ICE MEASURED IN SITU BY RADAR WIDE-ANGLE REFLECTION,
Wisconsin Univ.-Madison. Geophysical and Polar Research Center.
For primary bibliographic entry see Field 2C.
W79-09366

TROPHIC CLASSIFICATION OF SELECTED COLORADO LAKES: LAKE CLASSIFICATION THROUGH THE AMALGAMATION OF CONTACT-SENSED DATA AND DIGITALLY PROCESSED MULTISPECTRAL SCANNER DATA ACQUIRED BY SATELLITE AND AIRCRAFT,
Jet Propulsion Lab., Pasadena, CA.
R. J. Blackwell, and D. H. Boland.
Report No. EPA-600/4-79-005, JPL Publication 78-100, January 1979. Prepared for the National Aeronautics and Space Administration, Washington, D.C. and the U.S. Environmental Protection Agency, Office of Research and Development, Las Vegas, Nevada. 210 p, 36 fig, 51 tab, 82 ref, 3 append.

Descriptors: *Remote sensing, *Landsat, *Trophic level, *Multispectral scanners, *Modular multispectral scanning, Colorado, Lakes, Data collections, Aircraft, Photographs, Monitoring, Lake morphometry, Areal, Surfaces.

An examination was made of the role of Landsat multispectral scanner (MSS) data when used with contact-sensed data in lake monitoring and survey programs. Attention was focused on Landsat, but data acquired from an aircraft-borne modular multispectral scanner (MMS) were also examined. The scanners were evaluated on their ability to do the following: estimate lake surface area, lacustrine trophic state, and several trophic indicators including Secchi disc, transparency, and chlorophyll a; and aid in the development of lake thematic photomaps. Contact-sensed, Landsat MSS, and MMS data relationships for nine Colorado lakes indicated: (1) both Landsat MSS and Bendix MMS give estimates of lake surface area which are of practical value, with the MMS yielding slightly better results; (2) regression models were developed from both MSS and MMS data for the prediction of specific trophic indicators, with the MSS-related model giving better estimates than the Landsat MSS-related model; (3) estimation of a numeric trophic state index was shown to be possible through the development of regression models using contact-sensed data and either MSS or MMS data, with the MMS-related model providing better estimates than the Landsat model; and (4) production of trophic index photomaps was feasible using contact-sensed data and either MSS or MMS data, with the MMS product being more accurate than the Landsat product. (Schaefer-IPA)
W79-09420

REMOTE SENSING APPLICATIONS TO HYDROLOGIC MODELING IN THE SOUTHERN SIERRA NEVADA AND PORTIONS OF THE SAN JOAQUIN VALLEY, VOL. I,
California Univ., Santa Barbara. Dept. of Geography.
J. Dozier, J. E. Estes, D. S. Simonett, R. Davis, and J. Frew.
Available from the National Technical Information Service, Springfield, VA 22161 as E78-10126, Price codes: A07 in paper copy, A01 in microfiche. Final Report, May 1978. For January 17, 1977 to March 16, 1978. 125 p, 25 fig, 17 tab, 105 ref, 1 append. NASA NSG-5155.

Descriptors: *Remote sensing, *Hydrologic data, *Hydrologic aspects, *Model studies, Albedo, Radiation, Snowpacks, Snow cover, Topography, Atmospheric physics, Cloud cover, San Joaquin Valley, Sierra Nevada Mountains, California, Analytical techniques, Satellites(Artificial), Landsat, Fergana Valley, USSR.

Part of a joint U.S. - U.S.S.R. cooperative project to apply remote sensing to hydrologic modeling and to develop an energy balance snowmelt model for large basins is presented. Methods for estimating the various soil thermal and hydraulic parameters required for input to soil-heat moisture transfer models were determined. Various models were surveyed and a list of attributes for the Southern Sierra model of soil-snow heat and moisture exchange was developed. A technique for modeling incoming longwave radiation in mountainous terrain was developed. This model should compute the variations in atmospheric emissivity, account for the effects of surrounding slopes, cloud cover, and forest cover; and be driven by a limited set of discontinuous surface measurements. A method for estimating the shortwave albedo of an alpine snow cover using satellite radiance measurements is presented. Relevant spatial, radiometric, spectral, and temporal characteristics of Landsat data are included. A topographic solar radiation algorithm for snowmelt modeling is discussed. The algorithm should be spectral and computationally economical, account for radiation variations, include calculations for reflected radiation, provide for attenuation by clouds, and be able to estimate atmospheric attentuation parameters. A preliminary description of the Soviet test site, the Fergana Valley, is included. (Schaefer-IPA)
W79-09422

APPLICATION OF LANDSAT TO THE MANAGEMENT OF DELAWARE'S MARINE AND WETLAND RESOURCES,
Delaware Univ., Newark. Center for Remote Sensing.
V. Klemas, D. Bartlett, G. Davis, W. Philpot, and R. Rogers.
Available from the National Technical Information Service, Springfield, VA 22161 as N78-17441, Price codes: A07 in paper copy, A01 in microfiche. Final Report for Period February 1976 - December 1977. Prepared for National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, MD. 1977, 141 p, 50 fig, 7 tab, 50 append. NAS5-20983.

Descriptors: *Landsat, *Remote sensing, *Watershed management, Wetlands, Satellites(Artificial), Data collections, Hydrologic data, Water pollution effects, Sediment distribution, Vegetation, Algae, Estuaries, Water management(Applied), Delaware.

Analysis of Landsat imagery was found to be useful in a number of applications to Delaware's marine and coastal environment. Satellite observations proved valuable in mapping the location, type, and extent of estuarine fronts in Delaware Bay over all portions of the tidal cycle. The observations agreed with boat measurements and model predictions. Oil slick prediction models for clean-up operations of oil slicks and other pollutants will benefit from aircraft tracking of the actual slicks and from Landsat observations of surface currents and frontal systems. A method is presented for determining by remote sensing the concentration of suspended sediment with only a limited amount of ground truth. Landsat was shown to offer an effective means of monitoring the dispersion and movement of ocean dump plumes, such as industrial waste dumped on the continental shelf. A technique is described to analyze coastal vegetation, by obtaining Landsat/multispectral scanner (MSS) - equivalent spectral radiances in situ and the transforming these and actual MSS data to atmospherically corrected reflectance values. Interpretation of Landsat data was shown to be a valid and valuable technique for evaluating the onshore impacts of offshore petrochemical development; the study site for this was the Kenai Region, Alaska. (Schaefer-IPA)
W79-09423

PRELIMINARY RESULTS OF PASSIVE MICROWAVE SNOW EXPERIMENT DURING FEBRUARY AND MARCH 1978,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
A. T. C. Chang, J. C. Shiue, H. Boyne, D. Ellerbruch, and G. Counas.
Available from the National Technical Information Service, Springfield, VA 22161 as N79-19519, Price codes: A06 in paper copy, A01 in microfiche. Report No. NASA TP-1408, March 1979. 113 p, 16 fig, 1 tab, 5 ref, 2 append.

Descriptors: *Remote sensing, *Snowpacks, *Runoff, *Microwaves, *Radiometers, *Water management, Colorado, Rocky Mountains, Ground truth, Density stratification, Snow management, Snowmelt, Water yield, Hydrology, Particle size.

A four-frequency microwave radiometer system attached to a truck-mounted aerial lift was used to gather data on snowpacks at three sites in the Colorado Rocky Mountains. The experiment was designed to determine if remote microwave sensing of snowpacks could be used to predict runoff amounts. Runoff from melting snow provides more than 65% of the stream-flow for most of the mountainous western United States. Accurate runoff prediction would allow more efficient management of water for hydropower generation, irrigation,

and domestic and industrial water use. Snow depth, density, and non-uniform vertical grain-size distribution were calculated from the radiometric data. These values were compared to actual measured ground truth data (density, temperature, grain size, hardness, and free-liquid water content) taken at corresponding sites. Results show a positive agreement and potential for using remote sensing for runoff forecasts. Ground truth and snow brightness temperatures data are included. (Seigler-IPA)
W79-09430

PRELIMINARY RESULTS OF SAR SOIL MOISTURE EXPERIMENT, NOVEMBER 1975,
Computer Sciences Corp., Silver Spring, MD.
B. J. Choudhury, A. T. C. Chang, V. V. Salomonson, T. Schmugge, Jr., and J. R. Wang.
Available from the National Technical Information Service, Springfield, VA 22161 as N79-16473, Price codes: A03 in paper copy, A01 in microfiche. Report No. NASA TP-1404, January 1979. 20 p, 5 fig, 2 tab, 12 ref.

Descriptors: *Soil moisture, *Synthetic aperture radar, *Terrain analysis, *Remote sensing, Missouri, Indiana, Soil surveys, Back scattering, Moisture content, C-46 aircraft, Polarization, Image films, X-band, L-band, Microwave images.

A synthetic aperture radar (SAR) system was used to measure soil moisture at sites in St. Charles, Missouri; Centralia, Missouri; and Lafayette, Indiana. The test sites were 4.83-km by 8.05-km rectangular strips of relatively flat terrain. Moisture ground truth measurements were made in a number of bare fields at each location. The Environmental Research Institute of Michigan's (ERIM) dual-frequency and dual-polarization side-looking SAR system on board a C-46 aircraft was used for the experiment. Operating frequencies were 1.304 GHz and 9.375 GHz. Horizontally polarized pulses were transmitted and both horizontally and vertically polarized return signals were recorded on the signal film simultaneously for each frequency. Ground soil sample of 0 to 2.5 cm and 0 to 15 cm layers were also collected for soil moisture estimation. Digital data and hard-copy image films from the optical processing of the signal films were analyzed and the relationship of radar backscatter to moisture content and surface roughness is discussed. Many difficulties associated with the processing and analysis of SAR imagery such as the uncertainty in the quantitative analysis due to the difficulty of quality reproduction of digital data from the signal films are discussed. Results indicate some potential for applying the SAR approach for soil moisture determination if these problems can be solved. (Seigler-IPA)
W79-09431

LANDSAT FOLLOW-ON INVESTIGATION NO. 22510: THE USE OF THE LANDSAT DATA COLLECTION SYSTEM AND IMAGERY IN RESERVOIR MANAGEMENT AND OPERATION,
Army Engineer District, Waltham, MA. New England Div.
S. Cooper, T. D. Buckelew, H. L. McKim, and C. J. Merry.
Available from the National Technical Information Service, Springfield, VA 22161 as E78-10102, Price codes: A08 in paper copy, A01 in microfiche. Final Report, November 1977. Prepared for the National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, MD. 157 p, 86 fig, 10 tab, 53 ref, 2 append.

Descriptors: *Landsat, *Remote sensing, *Reservoir operation, *Watershed management, Water resources development, Reservoirs, Satellites(Artificial), Data collections, Hydrologic data, Wetlands, Analytical techniques, River forecasting.

Progress made by the New England Division, Corps of Engineers (NED) in utilizing Landsat data and imagery products in watershed management is documented. A description of sensors and interfaces developed for measuring water related parameters is included. In the investigation of the Landsat data collection system (DCS) it was shown that: (1) the reliability of the data collection platforms, Landsat itself, and NED's downlink were high; (2) component redundancy was an important consideration; (3) a potential increase in ability to function in the flood control mission was due to the installation of the DCS downlink; (4) a single Landsat was suitable for data needed daily or twice daily; (5) costs of the system could be less than comparable line-of-site radio systems; and (6) a geosynchronous satellite having random reporting would be the ideal system. The investigation showed that the Landsat DCS is suitable for monitoring events for which dependable sensors are available; a system of polar-orbiting satellites would be useful for collection of hydrologic data such as river stage and precipitation. It is recommended that the Landsat digital data be used in regional evaluation of wetlands when a mapping accuracy of 75% is required. (Schaefer-IPA)
W79-09437

SIERRA COOPERATIVE PILOT PROJECT, 1977-78 DATA INVENTORY, PROJECT SKYWATER.
Bureau of Reclamation, Denver, CO. Office of Atmospheric Resources Management.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-285 405, Price codes: A07 in paper copy, A01 in microfiche. June 1978. 130 p, 33 fig, 37 tab.

Descriptors: *Weather modification, *Weather data, *Cloud seeding, Cloud physics, Meteorology, Instrumentation, Sierra Nevada Mountains, Nevada, California, Sierra Cooperative Pilot Project, Data collections, Satellites(Artificial), Aircraft, Landsat, Precipitable water.

A complete inventory of all data collected in association with the Sierra Cooperative Pilot Project (SCPP) during the 1977-78 winter season is presented. The information is divided into 13 sections: (1) site maps; (2) radar; (3) satellite; (4) aircraft; (5) rawinsondes and pibals; (6) acoustic sounder; (7) precipitation gages; (8) snow profile; (9) joss disdrometer; (10) ice crystal and ice nucleus; (11) transport and diffusion; (12) project surface observations; and (13) National Weather Service (NES), Federal Aviation Administration (FAA), and National Climatic Center products. Most of the sections are further subdivided into: (1) a general description of equipment, modes of operation, and types of data available for analyses (both visual products and computer files); (2) samples of primary visual products; and (3) tables of data inventories which list start and stop times, locations, and other pertinent information related to data sampling. (Schaefer-IPA)
W79-09438

DESCRIPTION AND FIELD TEST RESULTS OF AN IN SITU COLIFORM MONITORING SYSTEM,
National Aeronautics and Space Administration, Langley Station, VA. Langley Research Center.
D. C. Grana, and J. R. Wilkins.
NASA Technical Paper 1334. 1979. 36 p, 23 fig, 1 tab, 5 ref.

Descriptors: *Coliforms, *Monitoring, *Aquatic bacteria, Electrochemistry, Standards, Water pollution, Bacteria, Water pollution sources, Microbiology, Data collections, Instrumentation, Bioindicators, Indicators.

A prototype in situ system for monitoring the levels of fecal coliforms in shallow water bodies is presented. The basis for the system was the known relationship between the concentration of the coliform bacteria and the amount of hydrogen they produce during growth in a complex organic media. The prototype consists of three parts: (1) a sampler platform at the bottom of the water; (2) a surface buoy which transmits samples-generated data; and (3) a shore station which receives, displays the data, and controls the sampler. The system was evaluated at four sites (three estuarine and one fresh water) which were characterized by a range of fecal coliforms from less than 1 to 2,000 per 100 ml of water. The evaluation verified the concept of remote monitoring of fecal coliform concentrations by an electrochemical detection method (EDM). The prototype system is envisioned as a monitoring tool rather than as a regulatory tool. A description of the test sites, results for each site, test preparation and procedures, and data analyses are included. (Schaefer-IPA)
W79-09439

TEST AND EVALUATION OF POTASSIUM SENSORS IN FRESH- AND SALTWATER,
National Ocean Survey, Rockville, MD.
G. K. Ward.
Report No. EPA-600/7-79-057, March 1979. Interagency Energy/Environment R and D Program Report. 61 p, 29 fig, 8 tab, 3 ref, 1 append. EAP-78-BEA.

Descriptors: *Potassium, *Electrodes, *Analytical techniques, Monitoring, Chemical analysis, Variability, Freshwater, Sea water, Atlantic Ocean, Chesapeake Bay, Stability, Light intensity, Instrumentation, Measurement, Calibrations.

Three types of potassium ion-selective electrodes, a glass-membrane single electrode, a glass-membrane combination electrode, and a liquid ion-exchange electrode, were tested and evaluated for suitability in monitoring or in situ chemical analysis systems. The electrodes were manufactured by different companies and were tested for accuracy, precision, temperature dependence, stability, durability, light intensity sensitivity, flow conditions variations, response time as a function of temperature and potassium concentration, and manufacturer variations. Tests were conducted in various types of water (Atlantic Ocean water, Chesapeake Bay Water, synthetic seawater, and fresh water) at 10C and 25C. Results show: (1) none of the electrodes exhibited a pure Nernstian behavior with a Nernst theoretical slope, (2) all three electrodes had significant drift problems, (3) an accuracy of 5% in concentration could be achieved with some sensors with proper and frequent calibration, (4) response times were long for all sensors -- generally greater than 10 minutes, (5) the two glass-membrane sensors were sensitive to motion and flow variations, and (6) all electrodes performed well in freshwater with slight differences in seawater. Recommendations for future development are included. (Seigler-IPA)
W79-09486

EVALUATION OF CALCIUM SENSORS IN FRESH - AND SALTWATER,
National Ocean Survey, Rockville, MD.
G. K. Ward.
Report No. EPA-600/7-79-058, March 1979. Interagency Energy/Environment R and D Program Report. 36 p, 16 fig, 6 tab, 4 ref, 1 append. EAP-78-BEA.

Descriptors: *Calcium, *Electrodes, *Analytical techniques, Chemical analysis, Measurement, Monitoring, Freshwater, Sea water, Atlantic Ocean, Chesapeake Bay, Stability, Light intensity, Calibrations.

The Orion Calcium Ion Electrode no. 93-20 was evaluated for its performance and accuracy in samples from freshwater, estuarine, and seawater environments. The electrode was tested with three separate 'liquid ion-exchange' type sensor modules. Descriptions of the sensor, operation, tests, and results are provided. Test parameters were; accuracy, precision, temperature dependence, stability, durability, sensitivity to fluctuations in light intensity and flow conditions, response time, and variability between modules. Evaluations were made at 10C and 25C in freshwater, synthetic seawater, and natural waters. Results show: (1) all sensors failed before their 'expiration dates', (2) the hard plastic electrodes are physically durable, (3) amount of available light had no effect, (4) all modules had a linear response in seawater, (5) reproducibility of a plus or minus 4% claimed by the manufacturer holds only if the sensor is calibrated hourly, and (6) the calcium electrode should not be used in freshwater without an ionic strength adjustor. The long response times (average of 33 minutes in freshwater) and sensitivity to flow conditions make

application of this calcium sensor to in situ measurements impractical. (Seigler-IPA)
W79-09487

STUDY OF WATER RESOURCES WITH THE AID OF SPACECRAFT IN THE UNITED STATES,
L. V. Dunin-Barkovskiy.
Available from the National Technical Information Service, Springfield, VA 22161 as N76-27651, Price codes: A02 in paper copy, A01 in microfiche. NASA Technical Translation F 17, 112, July 1976. 18 p, 1 tab, 5 ref. Translation of 'Izucheniye vodnykh resursov s pomoshch'yu kosmicheskikh sredstv v SShA', Vodnyye resursy, No. 1, p 60-68, 1976.

Descriptors: *Remote sensing, *Satellites(Artificial), *Reviews, *United States, Reservoirs, Mathematical models, Floods, Water quality, Vegetation, Water resources.

A detailed study was made of the results of research using remote sensing for studying water resources in the United States. Research on using remote sensing for studying water resources has been assigned by the National Aeronautics and Space Administration to certain universities and specialized firms for several years. For this purpose, manned and artificial Earth satellites have been used. However, before the stage of practical use it has only been possible to carry out a limited amount of research, which includes the following: determining the rain runoff from reservoirs in an arid zone, establishing the regions of flooding by flood waters, and determining the pollution of estuaries and bays. (Sims-ISWS)
W79-09501

A COMPUTER SOFTWARE SYSTEM FOR INTEGRATION AND ANALYSIS OF GRID-BASED REMOTE SENSING DATA WITH OTHER NATURAL RESOURCE DATA,
Michigan State Univ., East Lansing. Remote Sensing Project.
S. E. Tilmann, W. R. Enslin, and R. Hill-Rowley.
Available from the National Technical Information Service, Springfield, VA 22161 as N77-16418, Price codes: A02 in paper copy, A01 in microfiche. Report, February 1977. 12 p, 3 fig, 3 tab, 1 ref. NASA NGL23-044-083.

Descriptors: *Remote sensing, *Michigan, *Data processing, *Computer programs, Natural resources, Land use, Water pollution, Water pollution sources, Waste disposal, Groundwater recharge, Erosion, Topography, Satellites(Artificial), Aircraft, Analytical techniques, *Windsor Township(MI), *Eaton County(MI).

This report described a computer-based information system designed to assist in the integration of commonly available spatial data for regional planning and resource analysis. The Resource Analysis Program (RAP) provides a variety of analytical and mapping phases for single factor or multifactor analyses. The unique analytical and graphic capabilities of RAP were demonstrated with a study conducted in Windsor Township, Eaton County, Michigan. For this study, soil, land cover/use, topographic and geological maps were used as a data base to develop an 11-map portfolio. The major themes of the portfolio were land cover/use, non-point water pollution, waste disposal, and groundwater recharge. (Sims-ISWS)
W79-09504

WATER WELL DRAW DOWN MONITORING SYSTEM,
Electromeasures, Inc., Ennis, TX. (Assignee).
C. D. Deal.
U.S. Patent No. 4,142,411, 7 p, 2 fig, 2 ref; Official Gazette of the United States Patent Office, Vol. 980, No. 1, p 58, March 6, 1979.

Descriptors: *Patents, *Measurement, *Drawdown, *Water wells, Flow measurement, Water table, Monitoring, Well data, Specific capacity, Electronic equipment.

A method and apparatus is described for measuring the draw down of a water well by making in situ measurements of the static and dynamic water table levels. A well bore located pressure sensor provides the hydrostatic pressures to a surface located electronic measuring unit which provides a draw down measurement directly in terms of feet of water. An extension of the method provides for combining the measured draw down parameter with water discharge pressure and water flow measurements to derive a set of data which uniquely characterizes the production capability of the well. The apparatus performs all measurements automatically and has provisions for producint a time history of the well parameters, and telemetering to a central station for monitoring and processing. (Sinha - OEIS)
W79-09517

BASIC INVESTIGATIONS FOR REMOTE SENSING OF COASTAL AREAS,
Environmental Research Inst. of Michigan, Ann Arbor.
For primary bibliographic entry see Field 2L.
W79-09525

7C. Evaluation, Processing and Publication

WATER-RESOURCES INVESTIGATIONS IN KANSAS--FISCAL YEAR 1978,
Geological Survey, Lawrence, KS. Water Resources Div.
H. E. McGovern, and L. J. Combs.
Geological Survey open-file report 79-561, January 1979. 85 p, 5 fig, 5 tab.

Descriptors: *Water resources, *Projects, *Kansas, *Water quality, *Available water, Groundwater resources, Surface waters, Data collections, Streamflow, Hydrogeology, Water wells, Aquifers, Sampling, Measurement, Sites, Maps, Publications.

Hydrologic investigations in Kansas during fiscal year 1978 consisted of collecting and analyzing data to assess the State's water resources, describe the framework of hydrologic systems, and provide quantity and quality of water data for optimum development and management. Surface-water studies were made to analyze long-term records of streamflow, basin and stream-channel characteristics, relations of rainfall and runoff, frequency of low flows and floods, interrelation of ground and surface water, and the effects of stream regulation on the quantity, quality, and availability of water supplies. Geohydrologic studies were made to determine the source, availability, quantity, and quality of water in the principal aquifers; evaluate long-range effects of irrigation, industrial, and municipal withdrawals; determine the potential for storage of liquid wastes; and prepare digital models for evaluating plans of aquifer development and management. Water-quality studies were made to define the physical, chemical, and biological character of surface and ground water; the origin transport, and character of solutes and sediment in streams; the areal and temporal changes in water quality; and the suitability of water for municipal, industrial and agricultural use. (Woodard-USGS)
W79-09394

APPROXIMATE WATER-LEVEL CHANGES IN WELLS IN THE CHICOT AND EVANGELINE AQUIFERS 1977-79, AND MEASURED COMPACTION 1973-79, IN HARRIS AND GALVESTON COUNTIES, TEXAS,
Geological Survey, Houston, TX. Water Resources Div.
R. K. Gabrysch.
Geological Survey open-file report 79-693, 1979. 5 sheets, 5 fig.

Descriptors: *Aquifers, *Groundwater, *Water wells, *Water level fluctuations, *Compaction, Land subsidence, Maps, Texas, *Chicot aquifer, *Evangeline aquifer, *Galveston County(Tex), *Harris County(Tex).

This report consists of: (1) Four maps that present data on water-level changes during 1977-79 in the Chicot and Evangeline aquifers and; (2) one set of graphs that present data on the compaction of subsurface materials for 1973-79. During 1977-79, groundwater pumping decreased in Galveston County and southern Harris County, Tex., and increased in northern and western Harris County. (Woodard-USGS)
W79-09395

WATER-RESOURCES INVESTIGATION OF THE U.S. GEOLOGICAL SURVEY IN MONTANA, OCTOBER 1978 THROUGH SEPTEMBER 1979.
Geological Survey, Helena, MT. Water Resources Div.
Geological Survey open-file report 79-418, April 1979. 40 p, 3 fig, 2 tab.

Descriptors: *Data collections, *Sites, *Hydrologic data, *Projects, *Montana, Water quality, Surface waters, Groundwater, Available water, *US Geological Survey investigations.

The report describes water-resources investigations of the U.S. Geological Survey in Montana, October 1978 through September 1979. Programs consist of (1) collecting hydrologic data on a continuing basis, (2) conducting water-resources appraisals of surface and ground water, (3) conducting supportive research in hydrology and related fields, (4) disseminating water data and results of investigations to the public, (5) coordinating acquisition of water data by Federal agencies, and (6) providing technical assistance in hydrologic fields to other government agencies. (Woodard-USGS)
W79-09397

WATER RESOURCES DATA FOR KENTUCKY, WATER YEAR 1978.
Geological Survey, Louisville, KY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-296 401, Price codes: A22 in paper copy, A01 in microfiche. Geological Survey Water-Data Report KY-78-1, March 1979. 502 p, 5 fig, 3 tab.

Descriptors: *Kentucky, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1978 water year for Kentucky consist of records of stage, discharge, and water quality of streams; stage and contents of lakes; and water levels and water quality of wells and springs. This report contains discharge records from 114 gaging stations; stage and contents for 14 lakes; water-quality for 29 stations; suspended-sediment data for 36 stations (6 daily); daily temperature for 40 stations; ground-water levels for 65 recording, 71 partial, and 1 flowing well; water-quality data from 5 springs and 30 wells; and miscellaneous temperature and specific conductance data from the 114 gaging stations. Also included are data for 126 partial-record crest-stage and 126 partial-record low-flow sites. Data collected at various miscellaneous sites are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Kentucky. (Woodard-USGS)
W79-09399

WATER RESOURCES DATA FOR SOUTH CAROLINA, WATER YEAR 1977.
Geological Survey, Columbia, SC. Water Resources Div.
Geological Survey Water-Data Report SC-77-1, March 1978. 232 p, 5 fig.

Descriptors: *South Carolina, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1977 water year for South Carolina consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 57 gaging stations, stage-only records for 1 gaging stations, stage and contents for 11 lakes and reservoirs, water quality for 19 gaging stations and 6 ungaged stations, and water levels for 24 observation wells. Also included are 48 crest-stage partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in South Carolina. (Woodard-USGS)
W79-09404

WATER RESOURCES DATA FOR SOUTH DAKOTA, WATER YEAR 1978.
Geological Survey, Huron, SD. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-296 426, Price codes: A15 in paper copy, A01 in microfiche. Geological Survey Water-Data Report SD-78-1, March 1979. 323 p, 6 fig.

Descriptors: *South Dakota, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1978 water year for South Dakota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 103 gaging stations, stage and contents for 9 lakes and reservoirs, water quality for 25 gaging stations and 62 wells, and water levels for 16 observation wells. Also included are 101 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in South Dakota. (Woodard-USGS)
W79-09405

HEADWATER LOCATIONS OF U.S. STREAMS TRIBUTARY TO ST. LAWRENCE RIVER BASIN BETWEEN WESTERN OHIO AND EASTERN NEW YORK, EXCLUDING LAKE CHAMPLAIN BASIN,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W79-09408

WATER-TABLE MAP OF KENOSHA COUNTY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
M. G. Sherrill, and J. J. Schiller.
Geological Survey Water-Resources Investigations 79-39 (open-file report), May 1979. 1 sheet, 5 ref.

Descriptors: *Maps, *Water table, *Altitude, *Contours, *Groundwater, Wisconsin, *Kenosha County(WI).

A map (scale 1:100,000) of the water table in Kenosha County in southeastern Wisconsin was prepared using water levels from more than 200 wells. The work was done as a cooperative project between the U.S. Geological Survey and the Southeastern Wisconsin Regional Planning Commission. The map shows the altitude of the water table in increments of 20 feet, with supplemental 10-foot contours. The altitude ranges from less than 580 feet at a point near Lake Michigan to more than 840 feet at a point near the western border of the county. (Woodard-USGS)
W79-09411

WATER-TABLE MAP OF MILWAUKEE COUNTY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
M. G. Sherrill, J. J. Schiller, and J. R. Erickson.
Geological Survey Water-Resources Investigations 79-40 (open-file report), May 1979. 1 sheet, 5 ref.

Descriptors: *Maps, *Water table, *Altitude, *Contours, *Groundwater, Wisconsin, *Milwaukee County(WI).

A map (scale 1:100,000) of the water table in Milwaukee County in southeastern Wisconsin was prepared using water levels from more than 135 wells. The work was done as a cooperative project between the U.S. Geological Survey and the Southeastern Wisconsin Regional Planning Commission. The map shows the altitude of the water table in increments of 20 feet. The altitude ranges from less than 540 feet in a cone of depression in the city of Milwaukee to more than 800 feet in an area along the western border of the county. (Woodard-USGS)
W79-09412

WATER-TABLE MAP OF RACINE COUNTY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
M. G. Sherrill, and J. J. Schiller.
Geological Survey Water-Resources Investigations 79-41 (open-file report), May 1979. 1 sheet, 5 ref.

Descriptors: *Maps, *Water table, *Altitude, *Contours, *Groundwater, Wisconsin, *Racine County(WI).

A map (scale 1:100,000) of the water table in Racine County in southeastern Wisconsin was prepared using water levels from more than 250 wells. The work was done as a cooperative project between the U.S. Geological Survey and the Southeastern Wisconsin Regional Planning Commission. The map shows the altitude of the water table in increments of 20 feet, with supplemental 10-foot contours. The altitude ranges from less than 520 feet at a point in a cone of depression in the eastern part of the county to more than 820 feet at two points, one along the border in the southwestern corner of the county and another in the northwestern corner. (Woodard-USGS)
W79-09413

WATER-TABLE MAP OF WALWORTH COUNTY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
M. G. Sherrill, and J. R. Erickson.
Geological Survey Water-Resources Investigations 79-42 (open-file report), May 1979. 1 sheet, 3 ref.

Descriptors: *Maps, *Water table, *Altitude, *Contours, *Groundwater, Wisconsin, *Walworth County(WI).

A map of the water table in Walworth County in southeastern Wisconsin was prepared using water levels from nearly 600 wells. The work was done as a cooperative project between the U.S. Geological Survey, the University of Wisconsin-Extension, Geological and Natural History Survey, and the Southeastern Wisconsin Regional Planning Commission. The map (scale 1:100,000) shows the altitude of the water table in increments of 20 feet, with supplemental 10-foot contours. The altitude ranges from less than 780 feet along parts of the eastern border of the county to more than 1,000 feet in a small area near the central part of the county. (Woodard-USGS)
W79-09414

WATER-TABLE MAP OF WAUKESHA COUNTY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
J. B. Gonthier.
Geological Survey Water-Resources Investigations 79-43 (open-file report), May 1979. 1 sheet, 7 ref.

Descriptors: *Maps, *Water table, *Altitude, *Contours, *Groundwater, Wisconsin, *Waukesha County(WI).

A map (scale 1:100,000) was prepared of the water table in Waukesha County in southeastern Wisconsin using water levels from more than 1,700 wells. The work was done as part of a cooperative project between the U.S. Geological Survey, the University of Wisconsin-Extension, Geological and Natural History Survey, and the Southeastern Wisconsin Regional Planning Commission. The map shows the altitude of the water table in increments of 20 feet, with supplemental 10-foot contours. The altitude ranges from less than 670 feet at a point along the east border of the county to more than 1,000 feet above sea level at three points in the central part of the county. (Woodard-USGS)
W79-09415

MULTILEVEL APPROACH TO URBAN STORM WATER SYSTEMS PLANNING,
Purdue Univ., Lafayette, IN.
For primary bibliographic entry see Field 6A.
W79-09488

8. ENGINEERING WORKS

8B. Hydraulics

PROGRESS REPORT TO THE ARKANSAS STATE HIGHWAY AND TRANSPORTATION COMMISSION FOR YEAR ENDING SEPTEMBER 30, 1978,
Geological Survey, Little Rock, AR. Water Resources Div.
M. S. Hines.
Geological Survey open-file report 79-523, 1979. 22 p, 1 plate, 1 tab.

Descriptors: *Floods, *Peak discharge, *Hydraulics, *Bridge design, *Arkansas, Open channel flow, Flood frequency, Drainage area, Streamflow, Flow rates, Hydrologic data, Geomorphology, Planning, Road design, Rainfall-runoff relationships.

The economic design of bridges and culverts requires a knowledge of the magnitude and frequency of floods for all size drainage basins. In addition, an analysis of the hydrologic and hydraulic characteristics at specific sites where unusual circumstances exist is a prerequisite to design. The Arkansas State Highway and Transportation Commission and the U.S. Geological Survey have a mutual interest in flood-frequency and open-channel hydraulics and are therefore cooperating in a program to provide information necessary to meet their objectives. This report summarizes peak stages and discharges for 106 sites on Arkansas streams. Drainage areas for the Ouachita River basin were delineated, planimetered, and compiled. A drainage-area report for the Red River basin was published in May 1978. Geological Survey personnel assisted in a dye study of flow direction and velocity in the Arkansas River at the East Belt Freeway crossing. (Woodard-USGS)
W79-09396

8E. Rock Mechanics and Geology

GUIDELINES MANUAL FOR SURFACE MONITORING OF GEOTHERMAL AREAS,
Woodward-Clyde Consultants, San Francisco, CA.
C. J. Van Til.
Available from the National Technical Information Service, Springfield, VA 22161 as LBL-8617, Price codes: A07 in paper copy, A01 in microfiche. Final Report No. LBL-8617, GSRMP-3, UC-66e, May 1979. Prepared for the U.S. Department of Energy, Geothermal Subsidence Research Management Program. 126 p, 30 fig, 12 tab, 38 ref, 7 append. W-7405-ENG-48.

Descriptors: *Geothermal studies, *Subsidence, *Monitoring, Energy conversion, Land subsi-

dence, Movement, Stress, Earth pressure, Geology, Soil compaction, Subsurface waters, Geologic investigations, Hydrogeology, Environmental effects, Maps, Aerial photography.

Guidelines are presented for the establishment of a program for the monitoring of surface movements (primarily subsidence) associated with the production of energy from a geothermal source. The major process which may cause subsidence in geothermal areas is considered to be the loss of pore space due to fluid withdrawal. Compaction of these intergranular pore spaces accounts for the major portion of subsidence, but experiments on rock core samples indicate that an increase in effective stress may also reduce the volume of fracture pore space. Purposes for monitoring include: (1) satisfaction of legal requirements, (2) protection of environmental features, (3) protection of man-made structures, (4) collection of data for enforcement purposes, (5) checking of engineering design features to reduce subsidence, and (6) research. Three major logical steps for developing a monitoring program are presented. The first, preliminary investigation, describes the basic types of information needed and what the information will be used for. Types of information include: geological maps and reports, topographic maps, aerial photographs, soil maps, climate and weather records, and site inspection. Design of the monitoring system, the second step, includes: defining the site, regional survey work, local survey work, and special monitoring. The third step, monitoring operations, involves construction, scheduling, measurements, and data handling. (Seigler-IPA)
W79-09485

8I. Fisheries Engineering

PREFERRED AND OBSERVED CONDITIONS FOR SOCKEYE SALMON IN OZETTE LAKE AND ITS TRIBUTARIES, CLALLAM COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
G. C. Bortleson, and N. P. Dion.
Geological Survey Water-Resources Investigations 78-64 (open-file report), 1979. 61 p, 17 fig, 6 tab, 17 ref.

Descriptors: *Sockeye salmon, *Spawning, *Stream fisheries, *Lake fisheries, Water quality, Water temperature, Dissolved oxygen, Fish physiology, Ecosystems, Streambeds, Lake beds, Gravels, Evaluation, Washington, *Ozette Lake, *Clallam County(Wash).

Ozette River and Ozette Lake and its tributaries in Washington have many of the water-quality and stream-hydraulic characteristics that are generally supportive of good sockeye salmon production. Ozette Lake is a large, deep lake and a natural rearing area and for young sockeye. In the summer of 1976 water temperatures preferred for the growth of young sockeye (45-68 degrees Fahrenheit) occurred between about 200 feet of depth and the water surface, or generally in the zone of steep temperature gradient. Dissolved-oxygen concentrations in excess of 8.0 milligrams per liter at all depths throughout the year provided an adequate supply of oxygen for sockeye production. In comparison with eight other sockeye-producing lakes in Washington and Alaska, the concentrations of zooplankton in Ozette Lake appear adequate to support the rearing of sockeye salmon. In Big River and Umbrella Creek, tributaries to Ozette Lake, the streambed areas with gravels suitable for spawning were calculated to be about 39,000 and 31,000 square yards, respectively. If those areas were completely utilized they would accomodate about 13,000 and 10,000 spawning sockeye females, respectively. (Woodard-USGS)
W79-09400

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information Center Services

DIRECTORY OF LOCAL ASSISTANCE CENTERS OF THE NATIONAL WATER DATA EXCHANGE (NAWDEX),
Geological Survey, Reston, VA. Water Resources Div.
M. D. Edwards.
Geological Survey open-file report 79-423, 1979. 10 p.

Descriptors: *Data storage and retrieval, *Information exchange, *Indexing, *Cooperatives, Assistance centers, Directory, U.S. Geological Survey, Water resources division, *National Water Data Exchange(NAWDEX).

The National Water Data Exchange (NAWDEX), managed by the U.S. Geological Survey, has established a network of Local Assistance Centers throughout the United States and Puerto Rico to assist users of water data in identifying and locating the data they need. This Directory provides the information needed to contact any of the established Centers. (Woodard-USGS)
W79-09406

10F. Preparation Of Reviews

SYMPOSIUM ON THE PHYSICS AND CHEMISTRY OF ICE,
For primary bibliographic entry see Field 2C.
W79-09342

THE DISTORTION OF A WATER MOLECULE IN ICE,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
For primary bibliographic entry see Field 1A.
W79-09343

CONFIGURATIONAL STATISTICS,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Physics.
For primary bibliographic entry see Field 2C.
W79-09348

THE CORE STRUCTURE AND THE MOBILITY OF DISLOCATIONS IN ICE,
Birmingham Univ. (England). Dept. of Physics.
For primary bibliographic entry see Field 2C.
W79-09368

STRUCTURE AND BEHAVIOUR OF GRAIN BOUNDARIES IN POLYCRYSTALLINE ICE,
Hokkaido Univ., Sapporo (Japan). Dept. of Applied Physics.
For primary bibliographic entry see Field 2C.
W79-09387

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W79-09396 8B

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CENTERS OF COMPETENCE AND THEIR SUBJECT COVERAGE

- Ground and surface water hydrology at the Illinois State Water Survey.
- Metropolitan water resources planning and management at the Center for Urban and Regional Studies of University of North Carolina.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Center of the University of Wisconsin.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.
- Water well construction technology at the National Water Well Association.
- Water-related aspects of nuclear radiation and safety at the Oak Ridge National Laboratory.
- Water resource aspects of the pulp and paper industry at the Institute of Paper Chemistry.

Supported by the Environmental Protection Agency in cooperation with WRSIC

- Effect on water quality of irrigation return flows at the Department of Agricultural Engineering of Colorado State University.
- Agricultural livestock waste at East Central State College, Oklahoma.
- Municipal wastewater treatment technology at the Franklin Institute Research Laboratories.

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2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

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